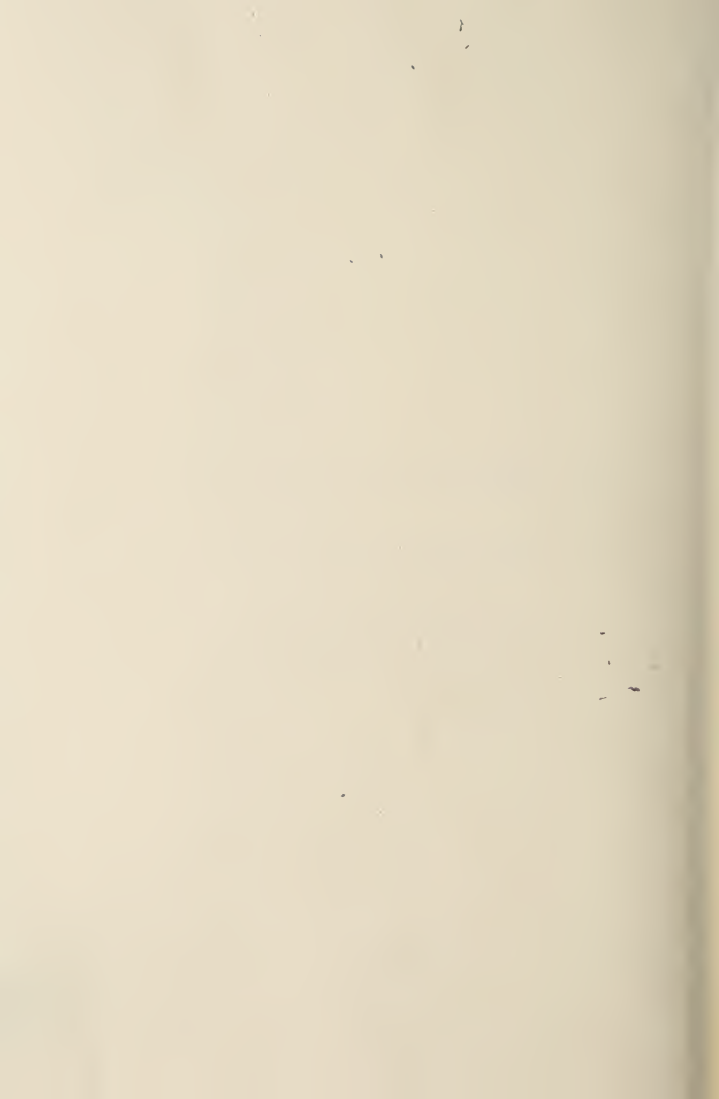




Digitized by the Internet Archive
in 2015

MARYLAND & RARE BOOK ROOM
UNIVERSITY OF MARYLAND LIBRARY
COLLEGE PARK, MD.



75
66
Set

DEPARTMENT OF ENTOMOLOGY
UNIVERSITY OF MARYLAND
COLLEGE PARK, MD.



UNIVERSITY OF MARYLAND
AGRICULTURAL EXPERIMENT STATION

MARYLAND & RARE BOOK ROOM
UNIVERSITY OF MARYLAND LIBRARY
COLLEGE PARK, MD.

**RESEARCH UNLOCKS
AGRICULTURAL RESOURCES
OF MARYLAND**

SEVENTY-SIXTH ANNUAL REPORT

BULLETIN A-139

JUNE 1964



RESEARCH UNLOCKS AGRICULTURAL RESOURCES OF MARYLAND

SEVENTY-SIXTH ANNUAL REPORT

1962-1963

**UNIVERSITY OF MARYLAND
AGRICULTURAL EXPERIMENT STATION**

**BULLETIN A-139
COLLEGE PARK
MARYLAND
JUNE 1964**

BOARD OF REGENTS OF THE UNIVERSITY OF MARYLAND
AND
THE MARYLAND STATE BOARD OF AGRICULTURE
1962-1963

CHARLES P. McCORMICK, CHAIRMAN, BALTIMORE
EDWARD F. HOLTER, VICE-CHAIRMAN, COLLEGE PARK
B. HERBERT BROWN, SECRETARY, BALTIMORE
DR. LOUIS L. KAPLAN, ASSISTANT SECRETARY, BALTIMORE
HARRY H. NUTTLE, TREASURER, DENTON
RICHARD W. CASE, ASSISTANT TREASURER, BALTIMORE
DR. WILLIAM B. LONG, SALISBURY
THOMAS W. PANGBORN, HAGERSTOWN
THOMAS B. SYMONS, COLLEGE PARK
WILLIAM C. WALSH, CUMBERLAND
MRS. JOHN L. WHITEHURST, BALTIMORE
WILSON H. ELKINS, UNIVERSITY PRESIDENT &
EXECUTIVE OFFICER, COLLEGE PARK, MARYLAND

UNIVERSITY OF MARYLAND
AGRICULTURAL EXPERIMENT STATION
COLLEGE PARK, MD.

*To The Governor of Maryland,
the Board of Regents,
and the President of the University of Maryland*

I transmit herewith the Seventy-Sixth Annual Report of the University of Maryland Agricultural Experiment Station, as established by Act of Congress, March 2, 1887, containing an account of research and experiments conducted during the fiscal year ending June 30, 1963, and a statement of the receipts and disbursements for the same period.

A handwritten signature in dark ink, appearing to read "I. C. Haut". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

I. C. Haut
Director

AGRICULTURAL RESEARCH ON THE CAMPUS AND IN THE FIELD

Farming requires ever new equipment, greater skill, more system, better education and specialized training. Vigilant agricultural research anticipates rural needs with intensive study, well-considered decisions, and services of many kinds.

The College of Agriculture, embedded fortunately in the heart of the campus, is reinforced by concentration and close association with other cultural and administrative units. Its campus offices, classrooms, libraries, laboratories and information services are brought within reach of all. The College is enabled to offer unexcelled leadership to students, research workers, and others and to the agricultural industry of the State.

Cooperation of science specialists, technicians, and extension personnel is readily available to everyone.



Growers examine sweet potato varieties at the vegetable research farm, Salisbury.



Four of the principal agricultural research buildings are grouped in this area on the north side of the Central Mall, between the Administration buildings and the McKeldin Library. In the foreground is Symons Hall, housing the offices of the Dean of Agriculture, and several department heads. It is backed by the Horticulture and Agricultural Engineering buildings and by H. J. Patterson Hall, with its facilities of Botany, Agronomy and other departments. Additional department facilities are on the northern part of the Campus.

Numerous illustrations accompany text on research projects.



EVALUATING A COW'S GROWTH HORMONES

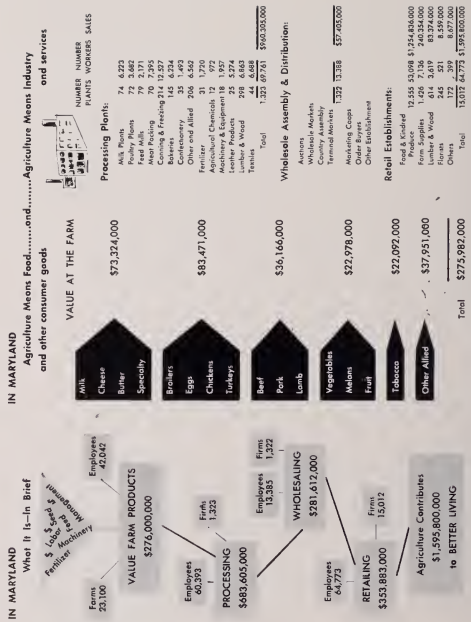
By using radioactive tracers which are counted by this equipment, a graduate student in the Department of Dairy Science studies ways in which growth hormones affect milk production and the metabolism of free fatty acids to acetic acid in the blood. Increasing the available acetic acid reduces the cow's burden of glucose metabolism. See page 61.

CONTENTS

The project number is given after each progress report. The title of the project and the personnel associated with it can be found listed among the current projects beginning on page 108.

	Page
Agricultural Research on the Campus and in the Field	iv
Agricultural Economics	1
Agricultural and Extension Education	17
Agricultural Engineering	18
Agronomy	23
Animal Science	39
Botany	47
Dairy Science	54
Entomology	66
Home Economics	73
Horticulture	75
Poultry	85
Veterinary Science	93
Station Staff	100
Financial Statement	101
Publications	102
Current Projects	108

MARYLAND'S AGRICULTURE—What it Is and What it Means to the Economy and to You



RESEARCH UNLOCKS AGRICULTURAL RESOURCES OF MARYLAND

AGRICULTURAL ECONOMICS

Research in the Department of Agricultural Economics is devoted to the application of economic analyses to the problems and opportunities of agriculture; including appropriate areas of farm production, agri-business and consumer demand, and the interrelationships of agriculture and the total resources of the economy. It involves the generation of knowledge on which to base decisions concerning efficient acquisition of farm production inputs, organization of on-farm resources, off-farm marketing processes, and the integration of business, human and other resources related to agriculture so as to contribute significantly to general economic development.

Forage Storage on Dairy Farms

Silage harvesting and silo filling methods vary widely among dairy farmers in Maryland. The most common silage harvesting pattern, however, based on data collected on Maryland dairy farms, was a three-man crew with three tractors, a forage chopper and two self-unloading wagons.

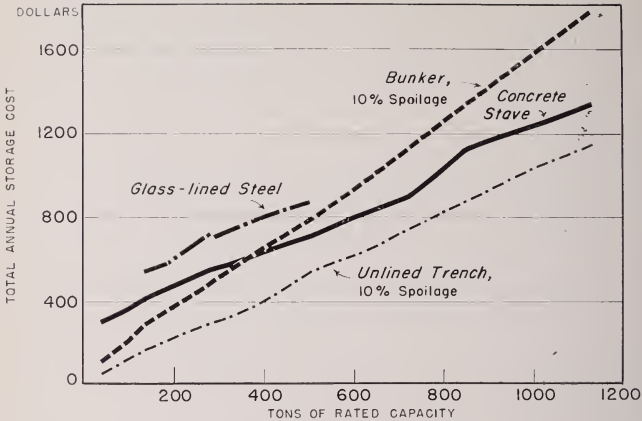
A silo filler was also required when filling a tower silo. A number of farms had two trucks for hauling silage, instead of two tractors and two wagons.

Four major types of silos were considered—the glass-lined steel, concrete stave, bunker, and unlined trench. Total initial costs increase as the storage capacity and size of silo increase for each of the four types of silos. However, the average initial investment per ton of rated storage capacity declines at a decreasing rate as the size of the silo

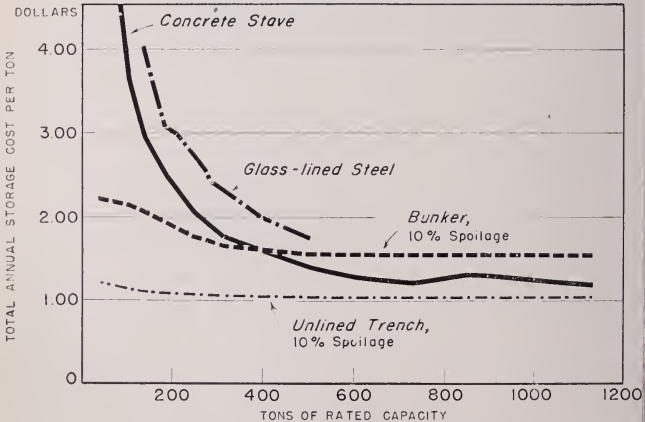
increases. Two variables, width and height, operate to cause this decreased cost per ton as size of silo increases. Increased width of tower silos causes costs per ton of rated capacity to drop sharply. A somewhat smaller cost-reducing effect is caused by increased height of tower silos.

At any given size or capacity of silo, the initial costs are lowest for trench silos with earth floors and earth walls. The bunker silos with concrete floors and wooden walls, the concrete-stave tower silos and the glass-lined steel tower silos have higher initial costs at any given capacity than the unlined trenches. At the 506-ton capacity, the initial costs are \$24.30, \$14.40, \$5.20 and \$0.25 per ton, respectively, for glass-lined steel, concrete-stave, bunker, and unlined trench silos.

COSTS



Annual silage storage costs, by type of silo, Maryland 1962.



Annual silage storage costs per ton, by type of silo, Maryland 1962.

In general, horizontal silos have higher spoilage losses than tower silos. Therefore, low valuations on silage spoilage losses will make the horizontal silos relatively more attractive than tower silos as low-cost methods of storage. Likewise, high valuations put on silage spoilage will make tower silos more attractive in terms of costs as a means of storing silage.

The unlined trenches can provide cheaper storage than the tower silos, even if spoilage losses amount to 10 percent of the total silage stored and are

valued at \$9 per ton of silage. The cost per ton of storing silage also is lower for bunker silos up to 350 tons of capacity. The concrete stave tower silos become a cheaper means of storage after this quantity.

Larger silos have a definite cost advantage over smaller silos within any type of silo groups considered. Large silos not only lower initial and annual costs per ton of capacity, they also have lower labor requirements per ton of silage.

Project A-18-ao

Profitability of Vegetable Production in Maryland

Vegetables for sale were harvested from approximately 72 thousand acres on more than 3500 farms in Maryland in 1959. This represented about 5 percent of the total harvested cropland and approximately one-sixth of the commercial farms in Maryland in 1959. Sales of vegetables represented about 5 percent of total cash farm receipts.

During 1949, vegetables were harvested from slightly less than 100,000 acres on almost 8,000 farms. Harvested vegetable acreage in 1949 accounted for slightly more than 6 percent of all harvested cropland in Maryland on about one-fourth of all commercial farms. However, sales of vegetables accounted for almost 5 percent of total cash farm receipts in 1949, as well as in 1959.

Profitability of various combinations of enterprises on any given farm may be measured in many dimensions. For example, some of the measures of profitability commonly used are (1) net returns to all resources during some given period, such as one year; (2) net returns to all resources during a period of several years; (3) net returns to all

fixed resources; (4) net returns to one resource, such as land, labor or capital, and so on.

Each of these measures is relevant for appropriate situations. For this study, the most profitable combination of enterprises was defined as that combination which could be expected to return the greatest value to farmer-owned resources. These were land, operator labor and management, and capital. Thus, the procedure consisted of finding that combination of enterprises from given alternatives, which would result in the greatest net returns to given bundles of these three resources.

Alternative enterprises included were: (a) dairy, (b) hogs, (c) corn for grain, (d) corn silage, (e) soybeans, (f) wheat, (g) barley, (h) hay, (i) pasture, (j) tomatoes, (k) snap beans, (l) sweet corn, (m) peas, and (n) lima beans. Vegetable crops were assumed to be produced for sale for processing. Forage crops were considered only as feed crops. Levels of technology and management assumed were (1) those common among farmers in 1961 and (2) those attainable by most farmers but

achieved by only the upper 25 percent of farmers in Maryland in 1961.

Three resource situations were studied, including a representative farm with 33 acres of land, 1.03 man-equivalent and \$10,000 capital investment; a farm with 190 acres of land, 1.79 man-equivalent, and \$35,000 capital investment; and a farm of 390 acres, 2.47 man-equivalents, and \$76,000 capital investment.

For price relationships in existence between 1949 and 1961, returns to farmer-owned resources were greatest

on the 190-acre farm, when 159 acres of snap beans were produced. An intensive dairy enterprise was second, a less intensive dairy enterprise was third, and the existing, or present dairy enterprise was fourth in the alternatives considered. Annual expected returns on the 190-acre farm for alternative enterprises are shown in figure 1. Expected returns from snap beans and tomatoes were much more variable than from other enterprises. This was due to greater variation in yields, as well as more volatile movements in prices.

A-18-ap



Producers, processors and distributors confer on consumers' problems, at new Adult Education Center, Maryland headquarters for advanced study.

Economies of Scale in Production of Fluid Milk

Data were obtained by mail-in questionnaires from 40 commercial dairy farmers in Frederick County, Maryland, and from the 1959 Census of Agriculture. The objectives were to determine the effect of herd size on present cropping system practices and livestock production, and to evaluate current and proposed crop and livestock systems on the basis of profitability, using partial budgeting techniques.

Dairy farms of 60 or more cows generally were found to use farm labor, land, capital and management more efficiently than dairy farms with less than 60 cows. Milk sales per man on the larger farms were 270,000 pounds for about 27 cows per man. The average output of four-percent milk per cow increased constantly as cow num-

bers per farm increased, for example, output on 20-cow farms averaged 7,770 pounds per cow and on 84-cow farms the average was 10,440 pounds per cow.

Fixed costs per unit declined as milk output increased. Corn for silage and grain, and alfalfa, produced feed nutrients at a lower cost normally than alternative crops.

Bulk tanks were used on all farms. Pipelines were used on only half the farms with over 40 cows and on no farm with 40 cows or less. Substituting capital in the form of a pipeline and reducing labor inputs raised net income when cow numbers were constant. This substantiated the argument that cost-reducing technology may be as profitable as output increasing practices.

A-18-ar

Levels and Variability of Prices of Maryland Products and Farm Resources

This study was designed to analyze past levels and variability of selected Maryland farm product and resource prices and to develop price projections, based on current and past relationships.

The shifts in supply and demand for individual farm commodities and resources, together with shifts in aggregate supply and demand, cause prices to vary over a period of years. In addition, changes in the value of money give rise to changes in the prices of individual farm products and resources, as well as changes in the general level of prices.

Data on annual Maryland farm product prices from 1910 to 1962 were tabulated and summarized for selected farm commodities: 10-20-30-year averages were calculated for annual average

prices of major farm products produced on Maryland farms. These data will be useful to managers of farms considering enterprise adjustments.

The results of this price analysis indicate there has been some reduction in the seasonal price variation patterns during recent years in both crop and livestock products. The more uniform flow of farm products to market during the entire year has been the major factor causing this reduction in seasonal price variations.

A more stable flow of products from farms and into normal distribution channels has resulted in efficiencies in the food-marketing system; more stable prices for consumers; and in many cases, improved production efficiencies

in the use of buildings, equipment and labor on individual farms.

Vegetable production continues to be an important part of many farm businesses in Maryland. Analysis of the organization and operation of commercial vegetable farms in the lower Eastern Shore led to findings which will permit farmers to more fully utilize their labor and other resources to add to their net income.

Data were collected and analyzed concerning the organization and allocation of agricultural resources on small to medium-sized farms on the lower Eastern Shore. A total of 151 alternative combinations were computed. The study provides guidelines for individual farmers to use in their efforts to maximize net income under existing restrictions.

Farm product sales, by counties, were summarized from census data; and past trends in the counties were analyzed for insight into the future shifts in values.

The role of the Northeast in U.S. farm production was analyzed. It was estimated that the Northeast will continue to shift resources from farm to nonfarm uses. Poultry and livestock will continue to contribute substantially to agricultural income in the Northeast.

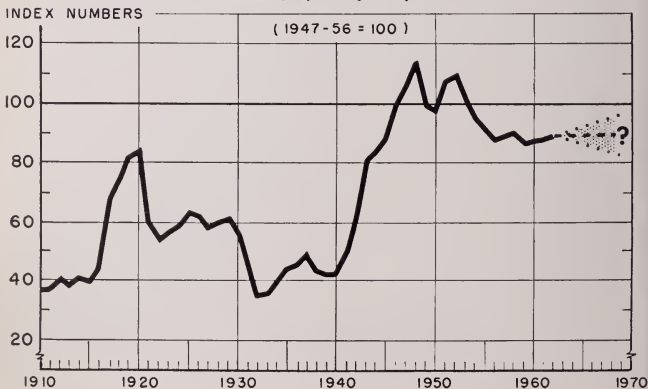
The level and variability of Maryland farm product prices were analyzed in terms of furnishing data for decision making in the years ahead.

These findings have been reported in University of Maryland Miscellaneous Publications series, Nos. 489, 488, 487, 485, and 483.

Project A-18-as

PRICE ANALYSIS

**All Commodities: Index Numbers of Prices Received by Farmers,
Annual Averages, Maryland, 1910 - 1962**



Acquisition and Use of Capital on Large Farms

As the size of farms continues to increase, with ever-expanding capital requirements, it becomes increasingly desirable that we understand the capital situation and problems of these large farms. Additional knowledge seems especially desirable in these economic areas: (1) the source of the capital being used to finance these large-farm businesses, (2) the farm operators' opinions as to the availability and adequacy of credit to finance these large-farm businesses, and (3) to understand better the capital structure of these large farms.

Some type of family assistance provided most of the capital for these farmers at the time they started farming. Inheritances, gifts, pay for working on the home farm and the contributions by the wife—also some borrowing were the major sources of capital. The largest part of the capital investment, however, consisted of the operators' net worth.

Of the average \$24,650 owed by

these farmers, \$19,792 was long-term mortgage credit; \$2,244 was intermediate credit; \$1,492 was 90-day to 3-year credit; and \$1,122 was 30 to 90-day credit. The primary sources of credit were commercial banks, individuals, Federal Land Bank, insurance companies and Production Credit Associations.

About 84 percent of the farmers interviewed were satisfied with the availability and adequacy of credit for financing their large-farm businesses. The remaining 16 percent expressed the opinion that credit was either unavailable, available only in inadequate amounts, or on somewhat unsatisfactory terms.

These farmers had average farm assets of \$124,436, distributed as follows: farm real estate, \$76,374; livestock, \$16,538; machinery, \$20,974; feed and supplies, \$10,550. Their average farm liabilities were \$24,650, leaving an average equity of \$99,786 in their farm businesses. *A-18-at*

Dairy Farm Adjustments and Supply Response In Maryland and the Northeast

Supplies of dairy products have caused concern at both the farm and market levels. The purpose of this study is to investigate the magnitude of future dairy adjustments and the aggregate supply response to be expected in Maryland under different economic conditions. During 1962-63, data obtained from 148 schedules taken in 2 areas in Maryland were summarized.

Preliminary analyses based on the data were made to determine methods of establishing benchmark farms. Work continued on developing technical input-output coefficients from data obtained in the survey schedules and through the resources of this station for the representative farms which are to be studied by the linear budgeting procedure. *A-18-au*

Hundredweight of Milk Sold Per Cow **Effect of different prices and sales per cow on basic dairy model with 106 Cows**



Economic Aspects of Beef Cattle Production

Numbers of beef cattle on farms in Maryland increased from approximately 80,000 head during 1945-48 to 164,000 in 1955. Since 1955, the numbers on farms remained near 150,000. While numbers of beef cattle in Maryland doubled between 1945 and 1960, numbers of beef cattle in the United States increased about 76 percent. Eight counties—Carroll, Frederick, Montgomery, Howard, Washington, Harford, Baltimore and Garrett—accounted for 74 percent of live cattle sales from Maryland farms in 1959. Production of milk also is important in these counties.

In many cases, the increasing number of beef cattle seems to be related to the increase in part-time farming. This is particularly true in areas in which off-farm employment is available. However, the numbers of farms on which

commercial production of beef cattle represents the most important source of cash farm income apparently increased during the last 20 years.

This study was organized to provide more information concerning the factors which affect net income from beef production on alternative beef production systems. Data were collected from beef cattle producers in Washington County, Maryland, in 1952. Selected characteristics of farms studied are shown in table 1.

Average total acres per farm ranged from 133 to 243 acres. The resident labor force, consisting of the operator and members of the operator's family averaged 0.77 man-equivalents to 0.90 man-equivalents. Thus, the operator was working off the farm in most cases.

studied. Total average capital investment per farm ranged from \$42,000 to \$76,000.

Beef cattle systems followed on these farms consisted of cow-calf herds from which either feeder calves, yearling stockers, or slaughter cattle were sold. Two other groups also sold slaughter cattle—purchased feeders at an average weight of 450 pounds in one group; and

those who bought stocker cattle at an average weight of 600 pounds.

Analyses of these data will indicate and provide information useful to farmers in making decisions relative to the prospective profitability of various beef cattle systems as determined by (1) quantity and quality of available resources, (2) production practices, and (3) relative prices of various types of cattle.

A-18-av

Selected characteristics, costs and returns according to beef systems—54 Beef Cattle Farms, Washington County, Maryland, 1962.

Item	Unit	Beef System				
		Cow-calf herds			Sell slaughter cattle	
		Feeder calves sold	Yearling stockers sold	Slaughter cattle sold	Buy feeders	Buy stockers
Number of farms	Number	11	12	11	9	11
<i>Land</i>						
Total	acres	133	187	243	164	206
Plowable	acres	66	131	221	153	192
<i>Labor</i>						
Operator and family	man-equiv.	0.75	.77	.96	.95	.93
<i>Capital</i>						
Total	\$1,000	42	52	68	57	76
<i>Animals</i>						
Cows	No.	26	22	27	—	—
Animals sold	No.	18	16	19	62	109
Animals sold	Wt.	460	605	995	1063	1061
Cash receipts	\$100	37	40	88	210	331
Cash expenses	\$100	34	30	52	154	285
Net cash income	\$100	3	10	36	56	45

Returns to Inputs on Cash Grain and Tobacco Farms

Returns to inputs on tobacco farms were studied in the first phase, which was initiated late in the 1962-63 fiscal year. The project was amended during the period to include a cost-of-production study. For this latter portion, data were collected on size of all tobacco

allotments in Southern Maryland. In a representative sample some 30 tobacco producers in the area started to keep detailed labor records on their tobacco enterprise. The study is continuing.

A-18-aw



Study of Algerian farming system—Maryland College of Agriculture representative discusses local Agricultural problems on the ground, through interpreter.

Organization of World's Agricultural Resources

Preliminary analysis is now complete on various representative or "classical" systems of agricultural-resource organization. A map in preparation will show the location of the most important of such systems in the world. A bibliography of references useful to the project has been published.

In the planning stage is a model which will serve as a general guide to the analysis of the various systems. A preliminary form of this model was recently tested in Algeria with the help

of a \$3,000 grant from the Agricultural Development Council. This enabled the project leader to conduct a field study on the structure of Algerian socialist agriculture.

The report on this project, now in print, should prove useful to any agricultural economist who is getting ready for his first cross-cultural experience either as a student or as a technical-assistance worker.

Project A-18-ax

Procedure for Equitable Taxation of Land

It is important that like properties be assessed alike for tax purposes. To this end, county assessment offices are striving to achieve more uniform approaches and procedures in assessing

farmland according to the Maryland land-tax law.

Several techniques in assessing farmland are being applied. In 2 of the 13 counties studied, assessed value rates

used in levying on each land class were uniform throughout the respective counties. In several other counties the variations in assessment rates were based on broad geographic or general soil-type areas, or even one kind of road bordering the property.

In most of the counties, however, assessed value rates on any land class varied within each county and even within election districts. Only two of the counties surveyed used, to any important extent, two or more assessed value rates on individual farms.

The annual review of properties for tax assessments abounds with problems, especially if properties have to be physically inspected each year. One alternative is a percentage or unit value mark-up because of lack of personnel to physically review properties within a reasonable time. Some method needs to be devised whereby it would not be necessary to physically review land, or even buildings, every year. The cost of annual visits to properties and record keeping in connection with such a procedure would be prohibitive.

Information on soils offers some possibility as an aid in assessing land. There is no certainty that soil ratings are always related to market price of

land, especially in areas where higher land use is in prospect. However, the basic qualities of soil which contribute to agricultural output under average management practices, might prove to be of assistance to assessors under Maryland's agricultural use value assessment law. In contemplation of this possibility, the State Department of Assessments and Taxation is experimenting with tax maps on which soil productivity groups are indicated by symbols on individual farms.

The extent and progress of the application of data on soils will depend partly upon the completion of soil surveys in the several counties. Only six of the counties have detailed soil maps. Other counties are in varying stages of surveying and of preparing maps. The fact that soil maps will not be available to or equally utilized by all counties could pose difficulties to equitable assessment among counties under the use-value assessment law. However, equitable treatment of individual properties within counties is fundamental to good assessment. Consequently, counties should not postpone the use of soil maps just because complete maps are not available for other counties.

Project A-19-z

Adjustment of Maryland Milk Processing and Distribution Systems

Seasonal shifts in both the demand and supply of Class II milk and milk products cause milk manufacturing plants to experience adjustment problems in the organization of efficient production plans. In order to possess sufficient plant capacity to handle the peak seasonal milk supplies, excess plant capacity normally exists during other periods of the year.

A regional project study of the Maryland and Virginia Milk Producers Pro-

cessing Plant was conducted to determine the extent of the seasonal underutilization of its labor and equipment. This study indicated that managers of milk processing plants may be able to increase labor utilization within the plant by assigning labor to various stations within the plant on a day-to-day basis, depending upon the product mix. In one plant it was found that by assigning labor on a day-to-day basis, requirements could be reduced by ap-

proximately five men. Increased utilization of the equipment in the plant, however, was directly related to the supply of milk and the product mix.

It was found that the plant has sufficient capacity to process the anticipated supplies of Class II milk through 1970. Because of anticipated increases in the supplies of Class II

milk, both equipment and labor efficiency should also increase through 1970. However, flexibility in the labor utilization within the plant and the selection of an optimum product mix are the best alternatives for reducing seasonal inefficiencies within the plant.

Project A-26-bc: NEM-25

Adjustments in Broiler Industry Related to Area Competition and Market Demand

In this study, the research and analysis of the impact preceded enactment of lower freight rates on feed ingredients. Prior to and during the period of study, proposals for reduced freight rates included (1) a 60-percent reduction in rates on coarse grain by Southern Railway, (2) a reduction in the arbitrary rate over Baltimore affecting the Eastern Shore and (3) an industry request to apply to the Delmarva area. At the time, surplus corn of the Commodity Credit Corporation was moving to grain-deficit areas under Section 22 rates, tending to place Delmarva at a further disadvantage in the broiler industry.

The study and report clearly pointed out the impact that reduced rates would have on Maryland's agriculture, in case the proposed reductions were enacted. The Maryland broiler industry

would be placed at a disadvantage of 4/10ths cent per pound over North Carolina and 1/10th cent per pound over Georgia, thereby changing the competitive position between Delmarva and the southeast areas.

The price of corn in Maryland would drop in proportion to freight rate reductions to the Eastern Shore under any of the proposals listed above, if granted. The estimated impact would redistribute income received by live stock and poultry producers and commercial grain producers.

Subsequently, rate reductions proposed by the Southern Railway were granted, the arbitrary rate over Baltimore was reduced, and a rate reduction of \$4.50 per ton on corn shipped from Ohio points to Delmarva was granted.

A-26-bd (RRF) NEM-21

Warehouse Facilities and Marketing Maryland Tobacco

A study of labor utilization in one of Maryland's two tobacco packing plants was conducted using the ratio-delay method in the auction season (late

spring) of 1963. Time did not permit analysis of the data before the end of the fiscal year 1962-1963.

A-26-bf(ES-699)

Impact of Farmer Cooperatives on Economy in Maryland

The results of an analysis of farmer cooperatives in Maryland indicate that farmer cooperative associations play an important role in the total agricultural economy in Maryland. Nearly 30 per-

cent of the total cash receipts from farm products marketed in Maryland was marketed through farmer cooperative associations.

Dairy products accounted for the

greatest percentage of total value of farm products marketed cooperatively. Dairy cooperatives handled between 75 and 85 percent of the milk marketed in Maryland (which comprises approximately 25 percent of total cash receipts to Maryland farmers.) Grain and soybeans were the second largest group of products marketed cooperatively, between 20 and 25 percent going to market through farmer cooperative associations.

Farmer cooperatives also play an important part in the purchase of farm supplies. Approximately 20 percent of the total farm supplies was purchased through farmer cooperatives. The most important item purchased cooperatively as a percentage of total purchases was petroleum products: with seeds, fertilizers, and feeds next in importance.

The total cooperative memberships held by Maryland farmers is estimated to be in excess of 100,000. Each farmer in the State belongs to an average of approximately 4 cooperatives.

In terms of dollar percentage, each farmer in Maryland does an average of approximately \$3,000 business with his cooperatives each year.

In addition to the farm population served by marketing and purchasing associations, 40,000 rural people were served by 2 Maryland rural electric cooperatives and another 4,000 farmers obtained farm credit through 7 local cooperative farm credit offices in the state. Additional services which are impossible to evaluate on a dollar basis were provided by various service cooperatives, such as farm labor cooperatives, breed improvement associations, and artificial breeding associations.

An analysis of cooperative pricing policies indicates that the majority of the purchasing cooperatives have adopted some type of differential pricing to accommodate large purchasers. There is, however, a need for a clearer statement of policy for all patrons.

A-26-bg

Future Consumption and Market Potential for Meats in the Northeast

During the 1962-1963 period slightly over 1800 households were interviewed in the cities of Baltimore and Washington, D.C. Two types of interviewing techniques were employed—the mail questionnaire, and the telephone survey. Tabulation of the questionnaires was initiated. Data analysis will be expedited through use of the IBM 7090 computer located on the University of

Maryland campus.

A publication, "Role of Meat Buying Specifications and Contract Livestock Production in Maryland," has been prepared. Data generated during this period was submitted to New Jersey Station to be included in a publication: "Specification Buying of Meats Within Selected Areas of the Northeast."

Hatch A-26-bh (NEM-28)

Effects of Changes in Transportation Rates On Delmarva Poultry Industry

Maryland broiler producers and processors have encountered increasing competition from southern broiler producing regions as a result of lower freight rates on the movement of corn

into the Southeast. However, Delmarva producers are located nearer the large Northeast markets in which a premium is paid for the heavier weight birds which they produced.

This project was initiated in an effort to evaluate the relative competitive position of Delmarva within the broiler industry under selected sets of conditions involving: (1) the estimated increased market requirements for broilers in 1965, (2) loss of premium in the Northeast markets, and (3) reductions in the transportation rates on corn shipments into the Northeast producing areas.

The results of the study indicate: (1) that Delmarva's cost per thousand pounds ready-to-cook is approximately \$6.00 to \$10.00 higher than the cost to southern producing areas. However, Delmarva probably will continue to expand broiler production, given existing

rate structures, so long as a premium is paid for birds from Delmarva; (2) an 8.6-cents-per-bushel reduction in the freight rates on the movement of corn into the Northeast would be necessary to offset the loss of a 1.5-cents premium for Delmarva's birds; (3) Delmarva broiler producers would tend to benefit more from rate reductions on corn shipments into the Northeast than would any other broiler producing area except Pennsylvania; and (4) the carriers of corn into the Northeast are not likely to reduce their rates by more than 11 to 12 cents per bushel, because the carrier's total revenue is forecast to decline in case of further rate reductions.

Project A-26-bi

Structure Changes in Northeast Processed Vegetable Industry

Characteristic of similar changes in other lines of industry, there have been evident changes in the number and size of fruit and vegetable-processing firms in Maryland and other northeastern states. The purpose of this study is to find the reasons for decline in the number of canning firms and to analyze the current status of the industry, as a basis for projecting the future size distribution of processing firms.

In the first phase of the project, interviews were arranged with 32 former owners of vegetable-processing firms that terminated business between 1951 and 1961. Information was obtained on longevity of each firm, type of business organization, age and experience of managerial personnel, reasons for cessation of operations, and factors related thereto as indicated by product mix, volume, raw-product sources, market outlets, and selling methods.

Similar information was included in data obtained through interviews with active vegetable-processing firms in the second phase of the study. Since this is part of a Northeast regional project, data were obtained from firms in Dela-

ware, Pennsylvania, and New Jersey, in addition to Maryland. Although collection and analysis of data are continuing, the information obtained from 47 active Maryland firms was used for comparison with the terminated firms.

Firms that had gone out of business differed from active processors by having been established more recently and having sold a greater proportion of their pack to grocery wholesalers. Most of the former firms packed relatively small annual volumes of canned vegetables; and 27 of the 32 firms packed tomatoes, including 19 that packed tomatoes only. A considerable number of these firms were packing most of their tomatoes in No. 2½ cans, which had decreased in market acceptance.

Findings of this study should prove useful in interpreting the changes that have taken place in market structure, and in assisting processors to make decisions concerning future plans for volume of pack, product mix, investment in improved or additional plant and equipment, and marketing arrangements.

A-26-bj



Despite its importance in general commerce and traffic, the recently completed Chesapeake Bay Bridge-Tunnel will probably have no impact on the shipping of soybeans or corn out of the port of Baltimore.

Impact of Bridge-Tunnel on Marketing of Soybeans, Corn, and Feed Derivatives of These Through Baltimore

Results of this study were delayed when the opening of the bridge-tunnel was delayed. Preliminary indications are that the Chesapeake Bay bridge-tunnel probably will have no impact on the shipping of soybeans, corn, and feed derivatives of these grains through the port of Baltimore.

To give a better picture of the poten-

tial impact this bridge might have on marketing patterns for these products in the Eastern Shore region, a study of current consumption and production patterns for soybeans and corn both on the Eastern Shore and in nearby regions was made. The results of this study will be published.

Project A-26 (bk)

Changes in the Northeastern Markets for Grain

The study has been organized as follows: (1) introduction, which outlines the purpose, scope, and objectives of the study and the basis for analysis; (2) historical background, in which shifts in production areas and the grain requirements of the Northeast are dis-

cussed; (3) sampling and statistical methodology; (4) movement of whole grain in the Northeast, which includes an illustrated flow chart and a description of the changes in the movement of whole grain through various market channels; and (5) the changes in struc-

ture and performance of terminal elevators, flour mills, feed manufacturing plants, and other grain processors. Country elevators and retail outlets are each considered separately.

Changes in the structure and trends in the performance of the grain markets of the Northeast are described and

evaluated, using major structural factors and performance measures. Suggestions for improving the grain marketing system are being built around a model of workable competition. Results of this study will be published.

Project No. A-26-b

Effect of Alternative Vining Methods on Quality and Processing Cost of Lima Beans

A large part of the cost of harvesting lima beans for processing consists of vining, which includes separating lima beans from the pods. Mobile viners have been developed as a means of mechanizing a process which formerly utilized much labor and handling. In a preceding study of the costs of harvesting with alternative methods it was found that use of mobile viners resulted in lower total harvesting costs than operations with stationary viners.

Processors recognized that lima beans harvested with mobile viners contained more trash and defects than those obtained from the "second viner" of the conventional stationary viners. In-plant operations to remove these defects conceivably might have resulted in additional costs, which could have nullified the savings obtainable by harvesting with mobile viners.

This study was made to find out whether there was a difference in costs or in the quality of the finished product of lima beans vined by mobile and stationary viners. Results of this in-plant cost study were to be combined with findings of the preceding harvesting-cost study in order to arrive at net differences, considering all costs of harvesting and processing.

A schedule was arranged wherein six processing firms harvested one-half of a 10-acre field by a mobile viner and the rest by a tandem stationary viner. These two lots of beans were separately

cleaned, washed and processed, so that samples could be taken at successive stages to test the effectiveness of the various machines in removing defects. Most of the trash and defects were removed by the cleaning and washing operations and only the relatively smaller amount of remaining defects would have to be removed manually at the inspection table.

In the following season samples were drawn after the washing stage. In a rotation of daily visits to 6 plants, 767 samples were drawn. Beans harvested with mobile viners had a significantly higher proportion of defects than those from either the single or tandem stationary viners.

Interviews with participating processors helped in estimating the inspection-table labor that would be needed to remove the known levels of defects from beans vined by each method. Allowance was made also for the value of field wastage and split or broken beans for each vining method.

The combined costs of inspection-table labor plus field losses and broken beans were greater for mobile than for stationary viners. When these costs were added to the field harvesting costs, total costs were lower for mobile viners if they were used to a capacity of 150 acres annually but there was less difference among vining methods with 50 or 75 acres annual utilization.

Project QA-58-S

AGRICULTURAL AND EXTENSION EDUCATION

Research in agricultural and extension education is concerned primarily with helping rural leaders in agriculture to work more effectively in raising the educational level of rural youth and adults. As research in technology reveals more and more new information, better methods of disseminating that information must be found. The rapidly changing patterns of human behavior should be based upon the latest and most accurate information available. Research in agricultural education aims to accelerate this process.

Academic Success Antidote for Student Dropout Tendency

The third of a series of reports on findings of progress of academic study and achievement by students in the College of Agriculture, now in preparation, indicates a growing tendency to place a premium on scholarship of able students and to win them deserved recognition. Yet the current loss of many students of marked ability is a

matter of concern. Measures to satisfy and retain able students are held to be at least as important as meeting the needs of students of apparently lower potentialities. Analyses of the reasons for academic success, as well as examination of the basic causes of student withdrawal, are under way.

Project T-6

Training of 4-H Club Leaders

It is the lay leader rather than the professionally trained person who provides primary instruction to 4-H Club members. Experienced county Extension workers recognize that effective lay leadership is requisite to success of the 4-H Club program. The effective training of 4-H Club lay leaders is an important determinant of the future progress of the program in the State. An understanding of the training received by leaders was needed by Extension administrative personnel in providing a basis for planning training programs for the development of desirable attitudes, understandings and behavior appropriate for county Extension staff members and 4-H Club leaders.

Data were collected and analyzed indicating the training received by leaders first-year from county extension staff

members. Although a majority of the leaders had received no instruction from county extension staff members, most of them reported that they should receive training and were willing to attend meetings as often as necessary. Of those who had received training, more than one-half the leaders reported that they participated in training activities only once. About one-fourth received training two or more times. The findings suggest that an induction training program for new lay leaders should be developed, involving state and county extension personnel and conducted annually on the county level. In keeping with the accepted educational principles, several training contacts, using a variety of materials, should be made over the course of the leaders' first year of service.

Project T-8

AGRICULTURAL ENGINEERING

Research in agricultural engineering has the objective of developing equipment, facilities or systems for producing, processing, transporting, storing, utilizing or marketing of plant or animal products. Research activities may be directed towards development of specific equipment, structures or system; or they may be oriented towards the determination of basic criteria for use in design of units for use on farms or in related off-farm industry.

Typically agricultural engineering research is conducted in cooperation with scientists of the commodity-oriented disciplines. The cooperation of scientists of other disciplines is recognized for their contribution in the conduct of the research projects summarized here. The summaries which follow have had the benefit of cooperation of those scientists. In addition to the work reported here the departmental staff members have served, formally and informally, as consultants on the engineering aspects of work throughout the Agricultural Experiment Station.

Environmental Requirements of Broilers

The objective of this study is to determine the effect of temperature and humidity on the efficiency of production of broilers. Tests were conducted in rooms of which the temperature and humidity could be precisely controlled ($\pm 1^\circ\text{F}$. wet or dry-bulb).

Three trials with four treatments each were made in the constant temperature and humidity environmental pens. Temperatures of 95° , 80° , 60° , 53° and 45°F . were used with a high and a low humidity condition at each.

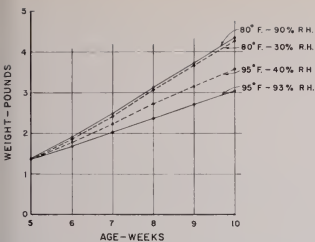
At high humidities when the temperature was lowered from 95° to 80° there was during the 5-to-10-week period a 43-percent improvement in rate of gain of 3.15 pounds for the 80° temperature. At low humidity this same drop in temperature improved gain by 21-percent to 3.19 pounds for the 80° temperature. Results were equal at 80°F .

When comparison of 60° , 53° and 45°F . temperatures were made, the 60° temperature gave the most satisfactory gains, with no noticeable humidity effect.

High mortality occurred during the period when temperatures were being lowered from 75° to test conditions. After this period the birds seemed to thrive satisfactorily.

Studies showed that the temperature has to be above 80°F . before there will be any adverse effect from high humidity. The results suggest that, once birds have become acclimatized to lower temperatures, they can thrive and perform satisfactorily.

Studies will continue covering additional combinations of temperature and relative humidities and their effect on broiler efficiency. These tests will start with the day-old chick instead of a 4-weeks old chick.



Effect of temperature and relative humidity on broiler weight. Humidity does not materially affect broiler weight until temperature is 80 degrees F. At average temperature, broiler growth rates are little affected by humidity.

Curing Maryland Tobacco

A new facility with a curing area of 8' x 44' for compact curing of Maryland tobacco was constructed.

Two cures of one-half acre each were made. Highly satisfactory quality and general appearance were obtained for both cures. The first cure, Catterton variety, when sold on the auction market averaged \$57.00 per 100-pounds and the second cure, Wilson variety, averaged \$51.00 per 100 pounds. Duration-of-burn tests were conducted; and there were no differences between the barn cured and the compact cured tobacco.

Chemical analysis for nicotine, nor-nicotine, total nitrogen, and protein nitrogen were made. Except for nor-nicotine the chemical compounds analyzed were all considered to be within expected values for Maryland tobacco. The trade feels there should be no more than 1 part nornicotine to 19 parts nicotine. This ratio was not attained by compact curing of the Catterton variety. This crop, however, was grown under extremely dry conditions which could have affected the chemical

In addition to the above tests under laboratory conditions, instruments were installed in broiler houses of two commercial growers to compare efficiency of production in insulated and non-insulated broiler houses. These studies indicate the desirability of better insulated housing from the standpoint of reducing cost of fuel and maintaining more uniform environment, however, management of houses is so variable that improved housing may not necessarily reduce the cost of broiler production.

Project RM-1

composition of the tobacco.

The tobacco was cured at a density of 8 plants per square foot of floor area and hung with the butts up. It was speared as closely as possible, 14 to 19 plants per stick. The sticks were hung about 7 inches apart. Air movement was from the top down, and at a rate of 60 cubic feet per minute per square foot of floor area. Supplemental heat was used for initial yellowing and during adverse curing weather conditions. The fan was operated only from 7 a.m. to 7:00 p.m. After the initial yellowing period, outside ventilation was adjusted so that the cured leaves were dried each day; if this could not be done with natural outside air, artificial heat was used. During the initial yellowing period the temperature was kept between 80-90° F. and the humidity high. When supplemented heat was used the thermostat was set for a maximum temperature of 100° F. Results indicate that a 90° F continuous temperature should be maximum; however, 100° F for a short period is not harmful.

RB-11-G



Compact curing facility. Air movement, temperature and relative humidity can be controlled during curing. This new facility is designed to "mechanize" the process of harvesting and curing tobacco and should reduce costs to a material extent.

Pneumatic Handling of Chopped Forage

Investigations were continued to obtain data to establish design criteria for a pneumatic system for conveying partly cured chopped hay. Experimental tests were made, using a $9\frac{1}{4}$ -inch-diameter pipe.

In all, 226 tests were run, using combinations of the following variables:

- 3 air velocities with zero rate of material; 4,300, 5,000 and 5,700 feet per minute.
- 4 material rates; 2.5, 5.0, 7.5, and 10.0 tons per hour.
- 4 moisture ranges; 20%-25%, 25%-30%, 30%-35%, and 45%-50%.

The data showed that for a given moisture content the air velocity decreased as the rate of material was increased. Within the moisture range used for the experimental tests, the

moisture content had little effect on the relationship between rate of material conveyed and the air velocity in the system. The friction losses in the experimental system increased as the rate of material conveyed was increased. The friction losses also increased as the air velocity in the system was increased.

A set of curves was developed showing the relationship among pressure drop in 50 feet of horizontal pipe, material conveyed, and air velocity used to convey material for a 14-inch diameter pipe and for a $9\frac{1}{4}$ inch pipe. The data can be used in designing pneumatic systems for conveying a given quantity of forage per hour.

Project R-16

Improvement of Sweet Potato Harvesting Equipment

Sweet potatoes were harvested under dry conditions. Damage seems to be more severe under these conditions than when the soil is wet, though no direct comparisons have been possible.

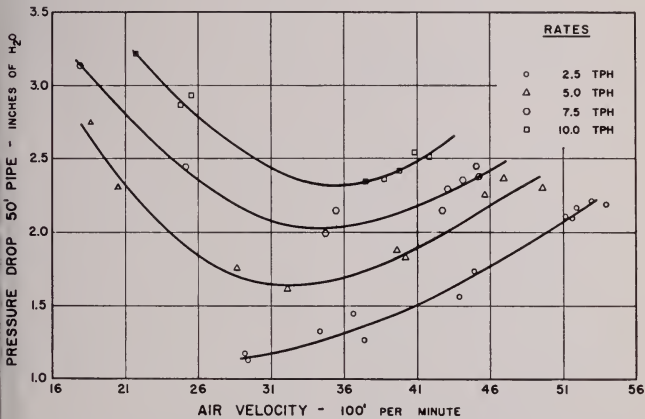
With the spreading vine type of sweet potato, such as Nemagold, rot injury was significantly higher when the digger chain was operated at 130 and 150 percent of ground speed than when operated at ground speed.

There was no significant difference

between operating the shaker bed at 0 rpm (no agitation) and at 531 rpm (theoretical 5Gs acceleration), indicating that little damage is done on the shaker bed.

Operating the detaching chain 10 percent slower than the digger chain appeared to provide more effective detachment, though traction difficulties made actual comparisons impossible.

Project R-18



Design curves showing pressure drop in 50 feet of a 9¼-inch horizontal pipe as a function of conveying air velocity and rate of material conveyed.

Facilities and Equipment for Agricultural Research

In addition to many small alterations and adjustments of research equipment for the several departments, a flame-ionization detector for use with a gas chromatograph was constructed for the Horticulture Department. A plant-

measuring aid was designed and constructed for the Agronomy Department to permit plant growth measurements on small plots without trampling of the plots.

Project R-21

Principles of Harvesting Root Crops

Studies were continued with the experimental root crop harvester. Analysis of root crop digging operations indicate that increasing digger-chain speed tends to eliminate the soil more rapidly. Most of the accelerated elimination of soil is attained between the blade and the chain, thus tending to reduce draft.

Increasing digger-chain speed tends to eliminate the soil more rapidly. Most of this takes place at the transition from blade to chain. Thus, higher chain speeds might reduce draft.

Limited tests in heavy soil at 1, 2 and 3 miles per hour indicated that the draw-bar pull was lowest with chain speeds of 85 and 150 percent of ground speed and highest at 100 percent. Additional work will be required to sub-

stantiate this finding and to check it for other soils and soil conditions. There was little difference in pull due to forward speed. There was no significant difference in skinning or bruising due to treatment, there being little damage with an overall average skinning score of 9.2 and bruising score of 9.7 on a basis of perfect score = 10.0.

When harvesting Nemagold sweet potatoes in dry sandy soil it was found that running the digger chain above ground speed significantly increased damage to the crop. Opening the elevator bottom so as to eliminate the soil more rapidly caused an increase in the damage at the higher relative chain speed.

Project R-20

Farmstead Water Requirements and Farm Waste Disposal

The Department has cooperated with the Livestock Engineering and Farm Structures Branch, Agricultural Engineering Research Division, USDA, in studies of farmstead water requirements and farm waste disposal.

Automatic equipment for recording water use has been designed and constructed for measuring water consumption at different places. Water meters which were modified to be effective with the recording equipment were installed on six farms to record water use at different parts of the farmstead water system. Water use data collection will be continued to permit more adequate design of systems to meet needs. A system was designed for a cooperating farm, using an intermediate storage tank filled from a low-yielding well. A second pump will draw from the intermediate storage tank to distribute water at high pressure to different points of the system.

Laboratory studies have shown that a loading rate of 0.01 pound of manure per day per cubic foot of water will effectively seal Manor soils against percolation. Manure from cows created a seal in 20 days, hog manure required 39 days and poultry manure required 59 days. Measurement of sludge accumulation such as would occur in lagoons from the same rate of loading showed only a trace for cow manure, indicating almost complete oxidation. Loading with hog manure resulted in a sludge deposition of only 1 millimeter (.03937—less than 4/10 of an inch) depth per month and poultry manure sludge accumulated at the rate of 1/8 inch per month. There were no odors from the laboratory experiment at these loading rates; however, when drained, the residual of poultry sludge gave off odors typical of poultry manure.

AGRONOMY

The research program in the Department of Agronomy is concerned with the development of improved crop varieties and better soil and crop management practices, with the goal of more efficient crop production. The size and importance of this task is emphasized by the many crops (corn, soybeans, tobacco, small grains, turf grasses, hay and pasture crops) and the wide range of soil conditions found in the state. To solve the soils and crops problems, basic and applied research work is conducted in the greenhouses and laboratories at the University, on the University Experimental Farms, and on the farms of cooperating growers throughout the state.

The following brief reports give the scope of the research work in progress.

Persistence Studies with Ladino Clover

A world collection of 528 Ladino and white clovers was evaluated. Although variation exists among entries for many traits, persistence is generally lacking. Persistence studies showed that an entomological-pathological complex is in-

volved, with emphasis on the entomological aspect. Management factors of potash fertilization, winter mulch, and reseeding practices did not affect persistence.

Project B-56-g

New Synthetic Varieties of Alfalfa and Grasses

New synthetic varieties of alfalfa, bromegrass, and orchardgrass are being evaluated under several systems of management in an effort to identify superior varieties of forages for Maryland and for the Northeastern region of the

United States. These test areas have been harvested 2 years and will be maintained for persistence studies. Synthetic varieties included in these tests were developed in the Northeastern region.

Project B-56-i

Red Clover Seed Needs New Rapid Test

Red clover is one of the major forage legumes in Maryland. Much seed is produced in the Mid-Atlantic States but considerable quantities are produced in the North Central and the Western States. Some is also imported from European countries. Many of these varieties and strains foreign to the Mid-Atlantic region are not adapted, are very susceptible to local diseases and will give poor results. By looking at the seed, one is not able to distinguish between the recommended varieties and the other varieties. Some seedsmen mix

these lots with a different origin in order to have more seed for the area or seed at a cheaper price.

Techniques are needed whereby seed-control officials and others can perform rapid tests in 4 to 8 weeks to evaluate a seed lot. Such techniques are being investigated under this project. The named varieties are being tested to ascertain the effect of the various treatments on their expression of variability both within and between varieties.

No conclusions have been reached at this time.

Project B-72

Effects of Clipping and Nitrogen on Grasses

First harvest yields of Potomac orchardgrass, Pennlate orchardgrass, Saratoga bromegrass and reed canary grass were increased as the first harvest was delayed. However, the quality of the forage was drastically reduced when it was harvested later than the boot stage. This was particularly true with the orchardgrasses.

The late head stage prior to flowering appeared to be best when one considers both forage yield and quality along with stand persistence. This was

particularly true with bromegrass, where stands were substantially reduced with harvests at the boot stage or earlier. Leaving the growing point of bromegrass and to a lesser extent reed canary resulted in better aftermath production and stand persistence. Stands of all grasses, except reed canary, were thinned with high nitrogen fertilization. The orchardgrasses were damaged least by mismanagement; bromegrass was damaged most.

Project B-73

Late Planting and Cold Tolerance in Oats

This project is designed to explore delayed planting in the nursery as a means of measuring both winter survival and the development of cold tolerance in varietal comparisons. The seven test varieties chosen initially for the project; namely, Cinarron, Early Wintok, LeConte, Wintok Dubois, Ballard and Nysel, were continued in periodic fall plantings at 10-day intervals both in nursery rows and in greenhouse flats placed outdoors near the nursery.

Although, on the average, winter survival as determined by stand estimates in the spring has decreased with

delay in planting, three varieties had stands from 81 to 89 percent in the second planting and from 60 to 63 percent in the last (Oct. 20) planting. The October 10 planting has been most useful as a measure of cold tolerance as determined by freeze tests on plants grown in flats. Freeze tests made on December 4, December 17 and February 11 showed an increase in hardiness for all plantings from the first freeze date to the second and a decrease from the second to the third. Apparently, some hardiness may be lost during winter months.

Project B-85 (contributing to NE-25)

Air Pollutants and Growth Repression

Growth repression by atmospheric pollutants under field conditions was determined by culture in a plastic house supplied with charcoal-filtered air, compared with parallel conditions and unfiltered air.

Higher ascorbic acid concentrations were found in leaves of tobacco subjected to 22-hour photoperiod than in controls; and they served as a protectant against ozone injury.

Plants grown at cooler temperatures were injured less by ozone, but lower

temperatures during fumigation increased injury. Lower relative humidities during fumigation induced stomatal closing and reduced injury. Some injury could occur, however, even with fumigation in the dark.

The use of plastic covers on tobacco seedbeds promoted earlier development and transplanting.

Solar radiation measurements indicated a pronounced canopy effect of mature tobacco.

Project BOQR-84(NE-35, Rev.)

Ammonium Fertilizer and its Retention in Soils

Reduction of ammonium and potassium fixation in soils has been shown to be definitely associated with organic materials. Some of these organic materials exhibited large differences in their influences on clay minerals in respect to potassium and ammonium fixation. For example, materials such as tetramethyl ammonium hydroxide decreases fixation and tetrabutyl ammonium hydroxide often increases it.

Tetraethyl ammonium hydroxide is intermediate.

It is suggested that natural organic materials may decompose to form organic materials, which then react with the clay minerals to influence ammonium and potassium fixation. Some of these materials may then increase ammonium and potassium fixation. Other organic materials may decrease fixation.

Project O-57(NE-39)

Consumptive Use of Soil Moisture by Field Crops

Adequate water is the most important crop-limiting soil factor on the average Maryland farm. Yields of corn, depending on the shortage of water, may vary from zero to 150 bushels. Other crop yields have similar dependence on soil moisture. This experiment started this year is designed to increase our knowledge of moisture use by field crops in relationship to weather and soil type.

Valuable information is being obtained on root distribution and mois-

ture extraction patterns of alfalfa, corn, soybeans, and bluegrass. Preliminary data show that none of these crops can extract water in or below the fragipan in the Beltsville soil which in some places is only 14" below the surface of the soil. Monmouth, Chester and Manor soils permit deeper extraction of water by the plants but limited root development below 18 inches reduces the uptake of water.

Project O-70(NE-46)

Formation and Destruction of Soil Aggregates Affect Yields

Soybeans in a rotation of corn, soybeans, and wheat yielded 34.4 bushels per acre in 1962, whereas continuous soybeans with a wheat winter cover crop produced 25.8 bushels. Increases due to rotation have been obtained in every year since 1956.

This experiment was started in 1952 but the effect of the rotation did not appear in the crop yields until 1956. All plots have been heavily fertilized

since 1952 (equivalent to 1000 lbs of 10-12-12 per acre per year) and soil tests show high levels of phosphorus and potassium. The soil structure and organic matter in the continuous soybean plots has declined rapidly while there has been only a small decrease in the rotation plots. The decline in soil structure appears to be the best explanation of the difference in yields.

Project O-56(NE-11)

Nitrogen-Fertilized Grasses or a Grass-legume Mixture for Cows?

In high-cost land areas farmers are forced to use the most efficient means of livestock feed production. Forage from perennial pasture grasses can be

greatly increased through the use of nitrogen fertilizer. It is the purpose of a cooperative study being conducted by the Departments of Agronomy and

Dairy Science to determine how dairy cows respond to these pastures. Results show that individual cows produce more milk on the clover-grass pastures than on the nitrogen-fertilized pastures. However, due to the greater dry-matter

production of the heavily fertilized grasses, carrying capacity and milk production per acre was higher on the high-nitrogen grass than on the clover-grass pastures.

Project BG-1

Summer Drought Helpful in Corn Evaluation

Lack of sufficient moisture frequently is the major limiting factor in corn production. Therefore, drought tolerance in commercial hybrids is a very desirable characteristic. Large rainfall deficiencies in 1962 at test locations limited yields 30 to 80 percent of normal, increased soil variability, and reduced differences in standability among test entries. On the other hand, useful data were provided for comparative drought tolerance. Some hybrids were consistently superior to others in this

respect. Details will be published.

A number of single crosses and 3-way crosses were compared with conventional double crosses. As would be expected, performance varied with the hybrid. At the low yield levels prevailing in the tests, yields of the better single and 3-way crosses were not significantly higher than those of the better double crosses. Several single crosses, however, were consistently above test average and seemed to tolerate drought comparatively well. *Project B-50, Hatch*

Pasture Species for Beef Production

Research data collected during the past 5 years have demonstrated that improved pastures and combinations of pastures can substantially increase beef production per acre. For example, Midland Bermudagrass in combination with sod-seeded rye has produced over 800 pounds of beef per acre in some years while other combinations seldom produced more than 400 pounds. By including Kentucky bluegrass pastures

along with Midland and sod-seeded rye it is possible to keep a near-uniform supply of pasturage throughout the grazing season. This type of pasture combination was found to be superior to an orchardgrass-clover, rye, and Sudangrass rotation in total beef production and in ease of management. Forage production was also better maintained during the drought of 1962.

Project B-56-j

Wheat with Stiff Straw

Soft red winter wheat varieties with short, stiff straw show to advantage when growth conditions promote lodging. In drill plot tests near College Park lodging for Redcoat, Dual and Knox ranged from 0 to 4 percent, while older varieties such as Thorne, Tayland, Leapland and Anderson with taller and weaker straw had from 30

to 80 percent lodging. In the nursery nearby several experimental selections produced better than 50 bushels of grain per acre without showing any tendency to lodge. Stiff straw combined with good mildew resistance should permit better grain yields through the use of more fertility.

Project B-66, Hatch

Winter-Hardy Improvement in Barley and Oats

The new barley variety, Besbar, compared with older varieties, was more productive than Wong and Kenbar and equal to Hudson. It headed 2 days earlier than Wong and was equally free of mildew. Twelve experimental lines carried in uniform barley nurseries rated especially well in that they combined good mildew resistance, stiff straw and above-average productivity.

The winter of 1962-63 was exceptionally rough on winter oats in Maryland and other northeastern states. Varieties recommended for years generally had less than 50 percent sur-

vival. Only one other winter (1958-59) in 19 years of oat testing on the University of Maryland Plant Research Farm has had as much winter killing in oats. The relatively hardy variety, Wintok, has been used as a standard of comparison in winter hardiness tests on this farm. In 1962-63 it came through with 88 percent survival and a yield of 40 bushels per acre. It is gratifying to say that five experimental lines showed equal hardiness and 25 percent better productivity.

Project B-67, Hatch

Use of Sod-Seeded Forage Crops to Supplement Existing Permanent Pastures

With medium nitrogen fertilization of Midland Bermudagrass total forage yields were increased by about 0.5 ton by the addition of sod-seeded rye, and with higher rates the gain was a ton and a half. More important than total yield, however, was the fact that forage production was distributed over a much longer period, thus making it more usable from the farmer's standpoint. A sod-seeded crop of rye appeared to be superior to a rye-vetch

combination when considering only total yield. The increased quality furnished by the vetch may, however, offset that advantage. The production of the Midland itself was only slightly reduced by the presence of the sod-seeded crop.

Pasture quality and yield of clover-deficient bluegrass pasture can be improved by use of improved methods of reestablishing clover into grass-dominant pastures.

Project B-75

Genetic and Breeding Studies in Red Clover

The polycross and selfed progeny from valuable clones selected from a large source nursery were evaluated. Based upon this information certain clones will be combined and the synthetic variety tested for yielding ability, disease and insect resistance, and other agronomic characters.

Inheritance studies on pseudo-self-compatibility were conducted and conclusions provided were: (1) Pseudo-

self-compatibilities of S_0 and F_1 plants of a cross were repeatable characters within the greenhouse; (2) pseudo-self-compatibility appeared to be a heritable characteristic; (3) the segregation of sterility genotypes at the "S" locus was significantly different from the expected 1: 1: 1: 1 ratio; and (4) pseudo-self-compatibility appeared to be associated with sterility allele genotypes in the F_1 cross studied.

Project B-76

Soil Test Studies

The high-frequency method of clay titrimetry as developed by the Univer-

sity of Maryland has been used to explain why differences occur in the ex-

change capacity determinations of soils when other systems are used; for example, the ammonium acetate method or the total sum of cation method. The high-frequency method is also useful in explaining some of the aluminum exchange reactions in soils. These reac-

tions are extremely important, as plant growth can at times be related to percentages of aluminum, calcium, magnesium, potassium and hydrogen saturating these exchange complexes of soil clays.

Project O-55 (Hatch)

Response of Certain Crops to Fertilizers as Related to Rates, Ratios and Methods of Application

Nutrient movement from the soil to the plant has been thought by some researchers to be, in part, the oscillation of the nutrient directly from the soil particle to the plant root. Maryland studies indicate that this hypothesis is questionable and they show that nutrients dissolved in the soil solution can be used to explain adequately the entire nutrient uptake by crops. This research suggests that soil scientists should concentrate on maintaining the soil solution at proper nutrient levels for good plant growth. *Project O-62*

The intensity of plant nutrient retention by soil clays is being studied by high-frequency titration.



Legume-Grass Mixtures and Differential Nitrogen Fertilization

Under what conditions should nitrogen be applied to legume-grass associations? Differential nitrogen applications were made on clover-orchardgrass associations containing varying percentages of legumes. Dry matter increases were obtained with each increasing increment of nitrogen at all Ladino clover percentages. Largest increases, however, occurred when the legume content was below 25 percent. In the case of red clover-orchardgrass, no response

to 100 pounds of nitrogen per acre was found when the percent of legume was 20 or above. Nitrogen content of the harvested forage was nearly the same for all treatments, due to changes in botanical composition of the sward during the growing season. Applying nitrogen to clover-grass mixtures, when the legume does not exceed 20 to 25 percent of the mixture, appears to be economically sound.

Project O-65

Nutrient Balance in Orchardgrass and Differential Fertilization

Nutrient balance is an important factor in obtaining maximum plant growth. During the summer of 1962, yields of Pearl millet forage were increased at moderate rates of phosphorus application only when the ratio of applied phosphorus to potassium was approximately 1 to 5. No response to magnesium was detected. Orchardgrass was used as the test crop on the same plot area in 1963. Evaluation of all the data taken in 1963 is expected to reveal additional nutrient-balance relationships among the elements tested. Knowledge of these relationships and their application should increase efficiency in forage fertilization.

Project O-71

The ultraviolet titration assembly is used in nutrient-balance studies for the determination of calcium in plant tissue.



Competitiveness of Crabgrass Under Varying Conditions

The competitiveness of plants can be caused by several factors, one of which may be a chemical inhibitor produced by the plant itself. In order to determine the presence of such an inhibition in crabgrass, extracts were prepared using 50 grams of crabgrass leaves in 100 mls of water. This was then used as a germination substrate for alfalfa, oats and wheat. Checks were germinated in water. In no case was germination affected. The data indicate that the large crabgrass (*Digitaria sanguinalis*) leaves have a rather high concentration of inhibitor, since growth of alfalfa and oats was approximately 10 percent that of the check. The small crabgrass (*D. Ischaemum*) extract appears to be less toxic, since only about 50 percent inhibition was found on any of the three species.

A field study involving a factorial experiment with 200 lbs of N, P_2O_5 and K_2O indicated that the addition of P_2O_5 increased plant height, fresh weight and dry weight. The potash had no effect on any of these three.

The effect of shade on growth and development of crabgrass was studied in the greenhouse, utilizing three levels of shade. The treatments were: no shade, 60%, and 90% shade. The most striking result of this experiment was the difference between large and small crabgrass in reference to the effect of medium shade. Large crabgrass under medium shade produced the same number of tillers as those in full sunlight. The small crabgrass under medium shade produced 1/5 the number of tillers as those in full sunlight. Also, the large crabgrass in medium shade

had the same fresh weight as that in full sun, but the small crabgrass growing in medium shade had a fresh weight of $\frac{1}{8}$ of that under the full-sun treat-

ment. In both species the heavy shade effectively reduced height and tillers per plant and the green weight.

Project B-95(NE-42)

Use of Herbicides to Control Weeds in Forages

Spring seedlings of alfalfa can be successful if weed control is obtained through the use of EPTC or 4-(2,4-DB). Where annual grasses were a problem, the use of EPTC as a preplant incorporated treatment, materially increased the chances of the seedling alfalfa.

If broadleaved weeds become a problem, 4-(2,4-DB) may be applied as a

postemergence treatment when the alfalfa passes the 3 true-leaf stage.

The use of dalapon to control grasses resulted in severe injury to the alfalfa.

Continuing trials to find an effective control for *Scleranthus annuus* (kna-wel) indicates that DN or CIPC, two old standbys in forage weed control, were still the best available right now.

Project B-79

Effect of the Herbicides on Plants

The herbicide atrazine has been considered a prime example of biological specificity of herbicides, since very low rates kill weeds, but even high rates do not injure corn. Recently some questions have arisen concerning the effect of atrazine on corn root growth.

In order to more adequately determine any effect of atrazine on corn and corn root growth, soybeans and corn were germinated in either 40 or 80 mls of an atrazine solution consisting of 1 gram of atrazine in 2000 mls of water. The corn showed no effect on germination and no effect on root length. It was noted in this preliminary study that the radicle of the soybeans was swollen and reduced in length. The primary roots from this radicle were also distorted.

Soybeans were allowed to germinate

in 40 or 80 mls of atrazine solution, in the dark. In this experiment an estimate of percent root damage was obtained. There was 16.6 percent root damage in the 40 mls of atrazine solution and 38.7 percent root damage in the 80 mls solutions, after the soybeans had germinated for 120 hours in the dark. The root length of both concentrations was 6.6 cm. The root length of the check was 7.5 cm. The percent root damage in the check was 0.0.

The experiment was repeated with corn. The percent germination was not affected by the atrazine solutions. The root length of the 40 mls solution was 12.4, that of the 80 mls solution was 11.8, and that of the check was 13.0. There was no indication at all, of any root damage or malformations in the atrazine-treated corn.

Project B-80



Importance of clean spray tanks. Knowledge of species susceptibility and herbicide injury symptoms, gained through work on project B-80, was responsible for identification of the cause of dead tobacco plants in a farmer's field. That oats and corn survived in the check soil (left), but oats were unable to survive in the treated soil (right) while corn grew normally, indicated that atrazine had been left in the spray tank after corn treatments.

Efficiency of Herbicides Used on Corn and Soybeans

The ability of pre-emergence herbicides to withstand a rotary hoeing and still deliver good weed control in soybeans is a characteristic of the herbicide itself. Such materials as dinitro or Randox are almost completely deactivated by a rotary hoeing or light cultivation, while Amiben, R-1607, or linuron maintain good weed control after rotary hoeing. This is important, since a rotary hoe must be used early to break a crusty soil.

In a field comparison of granular versus spray applications, little difference in efficacy was apparent.

A field trial was designed to test the residual control obtained by using spray and granular formulations under irrigated and non-irrigated conditions. The granular formulations provided better control of the test species. This control also continued to be superior throughout the experiment.

In a greenhouse test, the sphere of influence of some herbicides on two

types of attapulgite clay granules was compared. A hard-burned attapulgite granule (LVM) was compared with a softer and supposedly more porous granule (RVM) to determine if this factor affected release of the herbicide. The LVM attapulgite clay granules, in general, produced slightly larger spheres of influence. The volatility and solubility of the herbicide seem to have the greatest effect on the sphere of influence of the granular materials. The more volatile herbicides produce a larger sphere of influence. The soluble herbicides also produce a larger sphere of influence. The soluble herbicides appear to leach downward into the soil and have little lateral movement.

A third investigation was conducted in the laboratory to determine the effects of various solvents and herbicides on the stability of LVM particles. The data show that the highly volatile solvents had little effect on the granules. When less volatile compounds were

used, the degree of destruction of particle structure increased as the viscosity decreased. Water caused the greatest amount of particle breakdown. The herbicides used caused little damage

to the structure of the particles. The major portion of the breakdown of the particle appears to be caused by the solvent used in the impregnation procedure.

Project B-94

Soybean Varietal Improvement, Seven New Kinds

Soybean acreage in Maryland increased from 113,000 acres in 1953 to 282,000 acres in 1963. Most of this acreage is located on the Eastern Shore, with smaller acreages in Southern Maryland and in the Coastal Plains area on the west side of Chesapeake Bay.

During this 10-year period seven new improved varieties have been released to Maryland farmers, replacing all but three of the varieties grown in 1953. This project has a direct bearing on the varieties used by Maryland farmers.

Breeding and testing programs are

changing from a high-oil bean to a high-protein bean. Oil and protein content of the seed are inversely correlated.

Project B-43



Harvesting and threshing soybean plots at Linkwood.

Effect of Various Legume Cover Crops on Maryland Tobacco Quality

Most of the benefits of longer rotations for Maryland tobacco are due to improved structure, water-holding capacity, and aeration. The conservation of nutrients by the alternate crops, plus the addition of organic matter, serve to stabilize the yield and quality of the crop despite rather large differences in moisture supply.

In a 3-year rotation, the choice of a wide range of alternate crops may produce no real differences in yield or acre value. Four combinations of red-

top and legumes produced identical results with redtop alone in an 8-year test at the University of Maryland Tobacco Experimental Farm. Vetch and wheat was somewhat superior to either crop seeded alone. Orchardgrass and Ladino clover did not equal the vetch and wheat combination in acre value. Volunteer weeds were poorer than any seeded crop, mainly due to the encroachment of undesirable weed species.

Project B-63

Effects of Nitrogen Rates and Clipping Frequency on Performance of Midland Bermudagrass

Excellent summer production of Midland Bermudagrass (*cynodon dactylon* (L) Pers.) is possible when adequate amounts of fertilizer are applied. Yields of over 8 tons are possible but such yields are often of questionable

quality. However, by imposing the proper harvesting schedule and fertilizer applications, high-quality forage yields of over 6 tons per acre are easily obtained. Midland Bermudagrass can be harvested frequently at a low height

without damage to the stand. Nitrogen fertilizer applied during a specific growing season not only increases the yield for that particular year but increases

the yield of subsequent years, as demonstrated by residual forage yields taken during the 1962 growing season.

Project B-74

Performance of Forage Crop Varieties

The number of forage crop varieties is steadily increasing as state, federal, and commercial agencies improve existing varieties and develop new ones. Chesapeake, which originated in Talbot County, continued its excellent performance among red clover varieties. Pilgrim Ladino clover, Midland Ber-

mudagrass, and Flemish alfalfas are exceptionally good varieties within each of the species. The upright types of birdsfoot trefoil, such as Viking and other improved varieties, yielded more than the prostrate types in tests in Howard County.

Project B-77

Control of Weeds in Cultivated Crops, Turf, and Brush

Post-emergence applications of herbicides in corn were continued this season in an attempt to find an herbicide which could be applied safely to the corn and to obtain weed control. Of several chemicals applied, only one, atrazine, could be applied over the corn plants without injuring them. This gave good control of young weeds, but not of more mature ones. The use of linuron or prometryne also gave good weed control, but if the material were allowed to hit the corn plants, they were injured. This calls for a directed spray, which raises problems of correct application.

In a continuing search for a pre-emergence herbicide that will give good weed control in corn, and not cause a residual problem in soils, several herbicides were applied pre-emergence to corn plots. One of these named CP 522 and one called SWEP, both gave good weed control with very little injury to corn. This area has been seeded with small grains this fall to pick up any residual problems in the soils.

The weed problem in soybeans continues to be a bad one. Pigweed at harvesttime as well as during the growing seasons seriously affects the quality of beans. There are several beanfield herbicides on the market which were applied in conjunction with some new

herbicides in an attempt to find a satisfactory one. This year there were two or three which show considerable promise. Trifluralin, R-1607 and linuron all gave good weed control with minimum injury to the soybeans.

Brush-control treatments applied to typical fencerow brush showed that the phenoxy-type compounds (2,4-D 2,4,5-T and silvex) still are among the best general brush-control chemicals. A new derivative of picolinic acid shows promise at low rates.

Plots with different species of grasses have been laid out and are now being treated with different herbicides to determine species resistance to various crabgrass and broadleaf herbicides. Results will be available next spring. The control of knotweed is a continuing problem in turf. The use of dicamba late in the fall has given good control and may be promising for this use.

Several materials were applied to transplanted tobacco this spring. The weed problem was very severe, in that crabgrass presented an almost solid stand in the plots. The use of R-1607, EPTC, or Diphenamid gave very good weed control throughout the season. Use of Diphenamid may present a problem, since it appears to injure the cover crop following the tobacco.

Project B-78

Summer Annual Management Study

Summer drought occurs frequently enough that many farmers include summer annual grasses in their forage programs as an "insurance" practice. These summer annual grasses are rapid growing, therefore, it is important to manage these forages for high yields of quality feed over a short period. Sudangrass, Pearl millet and a sorghum-Sudangrass hybrid are being

compared under pasture and green-chop management with three stubble heights and two nitrogen levels. Green-chop management with a 4-inch stubble height appears to be more productive than the other treatments. High nitrogen fertilization has given no measurable response on these grasses.

Project B-82

Forage Crop Development Under Controlled Soil Temperatures

Experimental results are often clouded by interactions with environmental factors, and it is often difficult to find the real reason for specific plant responses. This present study is being conducted in order that basic information can be obtained about the in-

fluence of soil temperature on the growth of forage crops under differential management systems. A second phase of the experiments is to develop equipment to be used in studying these temperature effects.

Project B-83

Corn Silage Study

Corn silage is potentially the highest producer of TDN per acre. Farmers attempt to realize this potential, and in doing so, frequently apply high rates of nitrogen fertilizer to the corn silage crop. Corn silage fertilized with 0, 100, 200 and 400 pounds of nitrogen was compared for yield and nitrate content in a study conducted at the Agronomy-Dairy Forage Research Farm. Yields were increased by $\frac{1}{3}$ ton dry matter per acre, with 100 pounds of nitrogen over the no-nitrogen corn, and $\frac{1}{2}$ ton

dry matter when 200 and 400 pounds nitrogen was applied. The two higher rates of nitrogen fertilizer caused a buildup of nitrate in the corn plant. This level was sufficiently high to be toxic to cattle at the time the silage was harvested. The nitrate was converted to nitrogen dioxide, a poisonous gas, in the ensiling process, but after the gas had disappeared the nitrate level in the silage was no longer toxic.

Project B-86

Maximum Production of Maryland Tobacco

Yields above 2,000 pounds per acre have occurred frequently in these experiments, with an absolute high above 2600 pounds. Quality has been maintained with 120 pounds per acre of fertilizer nitrogen, with only a 2-cent-per-pound drop from the maximum at the 90-pound rate. There was a marked drop in quality when 180 pounds of nitrogen per acre was applied.

Varietal differences have favored Wilson in every case, as it has always had the highest yields, and has been second only to Catterton in price per pound. In 1962, Wilson returned \$1257 per acre; in 1961 with more favorable rainfall it grossed \$1347. By comparison, Catterton was valued at \$939 per acre in 1962 and \$1238 in 1961; Moore returned \$1109 in 1962 and \$1192 in 1961.

Average yield of tobacco in Maryland in 1962 was 950 pounds per acre and the 1963 crop forecast was 800 pounds, with acre returns in the \$500-

\$600 range. Many farmers are now averaging over 1500 pounds per acre; and some have grossed over \$1000 per acre.
State Project B-87

Physiological and Physiochemical Relationships of Tobacco

The detrimental effect of curing under conditions of high humidity were more pronounced in tobacco grown in a wet season such as 1961 than in 1962, a drier year. Tobacco cured in controlled atmospheres at 85° F. and 90 percent relative humidity was compared with tobacco cured at 95° F., and 85 percent relative humidity, a more favorable combination. The average loss in per acre value of four varieties was \$216 in 1962, \$279 in 1961. Wilson, however, suffered much greater losses —\$346 in 1962 and \$596 in 1961.

Alkaloids were degraded more rapidly under moisture curing conditions, perhaps by nicotine-loving organisms transferred from the soil. The loss of dry weight is due to common cellulose-destroying organisms such as *Alternaria tenuis*. There is a sharp decrease in tensile strength, as much as 20 percent with the heavier leaves, up to almost complete loss of the thinner and more fragile leaves. Nitrogen content of the leaves is at least 30 percent lower with improper curing.

State Project B-89



The content of nicotine and other alkaloids in Maryland tobacco is measured with a recording spectrophotometer in studies of physiochemical changes in the crop.

Efficiency of Midland Forage Production Improved by Nitrogen

Forage production was more uniformly distributed with four rather than two applications of nitrogen. Greater efficiency in forage production of Midland usually was obtained with ammonium nitrate rather than urea. Nitrogen content of the forage and nitrogen recovery were also higher with ammonium nitrate. Residual forage yields obtained in 1962 after nitrogen

had been applied in 1960 and 1961 showed a slight carryover of nitrogen at the first harvest of all treatments. By the end of the season there were no differences in yield except where 800 lbs. of N had been applied. In this case also yields were higher for the ammonium nitrate than for urea.

Project B-93

Tobacco Seedling Uniformity

Uniformity of time of seedling emergence was improved by the higher rates of irrigation. This resulted in more regular-sized plants and a more consistent stand. Uniformity of seedling emergence was correlated with the uniformity of the plants drawn for transplant-

ing in the field.

The number of healthy transplants drawn from stands under the lower rates of irrigation was less than 10 percent of the number drawn from those under the high rate of irrigation.

Project B-96



Use of irrigation. Upper—A consistent stand of regular-sized plants was realized where irrigation was used at 36 gal per 100 sq yds applied every day.

Lower—An inadequate stand of very irregular-sized plants was given by an irrigation rate of 36 gal. per 100 sq. yds. applied every 3 days.

Development of Improved Strains of Tobacco

Fifty lines of Maryland tobacco were screened for Wildfire (*Pseudomonas tabaci*), black root rot (*Theilaviopsis basicola*) and tobacco mosaic. The resistance to these diseases was incorporated from three related *Nicotiana* species. Lines observed to be resistant to these diseases were inferior in yield and quality to presently grown varieties in the variety trials; however, additional selection should improve their characteristics.

Two black shank (*Phytophthora par-*

asitica var. *Nicotianae*) resistant lines were tested along with 14 other lines or varieties in the variety trials. Even though the quality of the two lines was superior, the yield was consistently below recommended varieties except in the presence of the disease.

Additional testing and selecting within local farm strains was conducted. Most of these strains were either lower yielding or no better than the recommended varieties.

Project J-95

Recent Advances in Classification of Maryland Soil Resources

Maryland soils have recently been placed into a revised comprehensive system of classification. The revised classification scheme is designed to include all of the soils of the world and to conveniently show genetic and practical soil-use differences between groups or classes of soils.

Each class is defined in terms of soil properties that can be measured quantitatively and that are known or assumed to reflect changes in soil genesis or development. The system contains 6 categories; the highest being very general and including only 10 classes for all the soils of the world; and the lowest being quite specific and including about 7000 classes for the soils of the United States.

Maryland soils fit into about 220

classes of the lowest category; which is the soil series. It is rather remarkable that the soils of Maryland are distributed among 6 of the 10 classes of soils of the world. This indicates a wide range of soil conditions in the state. It is also noteworthy that over half the soil series fall within one class of the order level. These soils are the deep ones with maturely developed profiles that occupy most of the older gently sloping to hilly (but not steep) landforms. Placement of Maryland soils into the revised classification system improves the organization of our knowledge about the nature and properties of the soils, and therefore will improve the accuracy of soil use and management recommendations.

Project O-48

Response of Orchardgrass to Application of Nitrogen

Four nitrogen sources were applied to orchardgrass forage at various times in the fall and in the spring to evaluate the feasibility of topdressing nitrogen in the fall for subsequent spring growth. The December 15 application was as effective as the March 15 topdressing in terms of dry matter yields. One exception was NH_4NO_3 which was less effective in December than March. This probably caused by leaching of the nitrate ion during the winter. Earlier applications of the soluble sources (urea, $(\text{NH}_4)_2\text{SO}_4$, and NH_4NO_3) were inferior to the December and March additions. The orchardgrass grew actively

into December and much of the nitrogen applied in early fall was used by the plant before spring. Of course, the early fall applications would have been desirable for fall grazing the same year. Urea formaldehyde did not perform as well as the more soluble sources. Nitrogen content of forage fertilized in December was slightly lower than that receiving nitrogen in March. Apparently, nitrogen can be applied economically to orchardgrass in late fall or early winter when workloads are reduced, fields are accessible, and fertilizer costs are low.

Project O-63

Effect of Nitrogen, Phosphorus, and Potassium on the Growth of Forages

Potassium is important in nutrient balance and wintering of forages. A nutrient-balance study of Midland Bernudagrass in which an optimum ratio of applied nitrogen to potassium was determined was continued. This ratio

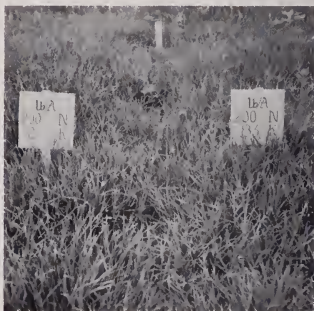
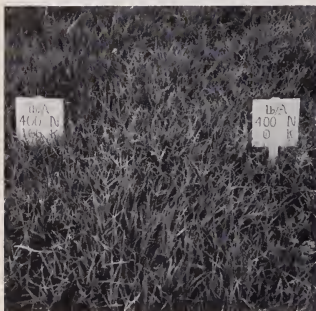
was the same (2.4 to 1) regardless of the nitrogen rate. Plants receiving sufficient potassium were more resistant to leaf spot disease and winter-killing than were those receiving little or no potassium. It is important to the farm-

er who uses heavy rates of nitrogen on Bermudagrass to pay particular attention to the availability of other essential elements.

Possible reasons for the beneficial effect of potassium on the wintering of alfalfa were revealed in another study. Potassium caused root xylem vessels to be large in diameter and evenly dis-

tributed. This phenomenon would allow "antifreeze materials" to be present in larger quantities and be effective in a greater portion of the root. Root-constricting organisms, such as nematodes, should find it more difficult to constrict the larger xylem vessels.

Project O-64



Efficient use of large amounts of nitrogen by forages requires balance with potassium. Note better yield, with increase of potassium (K) at left.

ANIMAL SCIENCE

Research in the field of Animal Science involves studies in the areas of breeding, feeding and nutrition, management, and meats, in connection with beef cattle, sheep, and swine. Significant increases in facilities are obtained through the generous cooperation of livestock producers and processors of meat, without whose help some projects could not be conducted. The recent opening of the University's Computer Science Center with its excellent computing equipment permits an expansion of the scope of some projects which will be of great ultimate benefit to producers.

NUTRITION

Studies in the field of nutrition are divided on the basis of the type of digestive tract into those involving rumi-

nant animals—beef cattle and sheep—and the non-ruminant swine.

Effects of Moisture in Forage for Sheep

Hay crop silages relatively low in dry matter have been shown to be less palatable in terms of dry matter intake than have "low moisture" or wilted silages, or hays made from forages of similar quality. The limitation in nutrient intake, of course, reduces the value of these "wet" silages as feeds for ruminants; and the nutritional worth of harvested forage seems to be correlated with dry-matter content. The low palatability of high-moisture silages has not been successfully linked with the bulk or weight necessary to yield some quantity of dry matter, nor can it be associated with percent digestibility or proximate analyses. The information presently available suggests that phenomena associated with the fermentation during the silage-making process are responsible for the low values of high-moisture silages. Studies of dry matter intake and rumen volatile fatty acid (VFA) production in sheep fed

on alfalfa and Sudangrass hays and silages are being conducted.

High-moisture (25-30 percent dry matter) alfalfa and early and late cut Sudangrass silage were stored in plastic bags. Artificially dried hays (90-92 percent dry matter) were made from the same cuttings of forages. When these forages were fed to ewes, the hays were superior to the silages in terms of dry matter intake and body weight gains. The low-moisture alfalfa silage did not appear to be as well preserved as the high-moisture silages in terms of color, odor, and freedom from mold and spoilage, but was more palatable to the ewes and supported a higher level of gain.

The late cut Sudangrass silage was especially unpalatable and the sheep consumed dry matter sufficient only for about 50 percent of the estimated maintenance requirement. In all cases, dry matter consumption seemed to be as-

sociated with dry matter content of the forages as fed when intake was compared within forage species and time of cutting.

Alfalfa was more palatable than Sudangrass, and the early cut Sudangrass was superior to the late cut. Supplementation of the late cut Sudangrass silage with 1.0 to 1.3 pounds of the alfalfa hay per ewe per day, did not increase dry matter consumption from the silage; thus, it would appear that

the low intake of the Sudangrass silage may not be associated with a low level of total dietary protein or some other obvious nutritional deficiency. VFA analyses of the silages and for rumen VFA in the sheep are being made. It is possible that VFA data will yield some information relative to the rate of ruminal fermentation or other factors which could affect the palatability of the various forage preparations.

Project C-25a

Dietary Nitrogen and Rumen Function in Sheep

The action of the microbial population of the rumen is known to be of great significance in the nutritional economy of the ruminant animal. The ability of the ruminant to digest fiber and to be largely independent of a dietary requirement for protein quality is due to the enzyme production and amino acid synthesis of the ruminal microorganisms. In the ruminal fermentation, carbohydrates are degraded to volatile fatty acids (VFA) and the absolute and relative quantities of the various VFA produced are known to be related to the nature of the carbohydrates fed. Generally, high fiber (roughage) diets result in the production of a preponderance of acetic acid and diets high in starch or soluble carbohydrates (concentrates) result in relatively high propionic acid production in the rumen. There is reason to believe that the ratios of VFA present in the rumen give an index to the nutritional status of the animal, as sheep or cattle on low-energy diets may be expected to have a very high acetate: propionate ratio in the rumen and this ratio will diminish as the energy level increases.

Past studies of VFA production in this laboratory support the theory that the rate of digestion of carbohydrates

influences the ruminal acetate: propionate ratio with a rapid fermentation favoring propionate production. It is not unreasonable to assume that the utilization of low-quality roughages which are high in fiber and low in protein is limited by the rate at which they are digested; and certainly, such feedstuffs can be demonstrated to be low propionic acid producers. Investigation of the effects of nitrogen supplementation of low-quality roughages upon their nutritional value and ruminal VFA production have been initiated.

Diets for lambs, made up largely of ground, pelleted corn cobs, have been supplemented with a liquid molasses-urea supplement (10 percent urea by weight). Urea supplementation significantly increased consumption of the pelleted diets and resulted in much greater body weight gains. Total ruminal VFA were increased by feeding urea, and the acetate: propionate ratio was reduced. Unsupplemented diets also resulted in a relatively high production of rumen butyrate with molar percent butyric acid exceeding propionic acid in some cases. The incorporation of soybean oil meal into the pelleted diets resulted in faster gain than those observed in lambs fed sim-

ilar levels of energy and nitrogen, as corn meal and urea; but no appreciable differences in ruminal VFA levels or proportions due to these treatments resulted.

Urea supplementation of barley straw allowed lambs to maintain body weight, while lambs with no supplementary nitrogen lost weight on the straw diets. In this case, the ruminal acetate: pro-

pionate ratio and the molar percent rumen butyrate were again markedly affected by nitrogen supplementation. Results to date indicate that, at least in the case of extremely low nitrogen diets, the ruminal VFA analysis will yield information relative to the nutritional status of the animal.

Project C-36

Nervous Involvement in Bloat of Sheep

It is generally accepted that bloat is more related to the inhibition of eructation (belching) than to rapid gas production, and that the contractions necessary for eructation are controlled through the autonomic nervous system. The parasympathetic nervous system is stimulatory and the sympathetic system is inhibitory to the musculature of the digestive tract. The presence of numerous nerve fibers in those parts of the rumen and esophagus which are actively involved in eructation has been demonstrated. Thus, it seems reasonable to postulate that bloat (a failure of eructation) is due to some disturbance(s) in that part of the autonomic nervous system controlling the digestive tract and that such disturbance(s) must be due to some component(s) of those feedstuffs that cause bloat.

Eructation occurs only when the intraruminal pressure, which stimulates the belching reflex, has increased enough to overcome the inhibitory factors. If the pressure required for the eructation reflex is great enough to cause distension of the flank and lower abdominal region the animal is bloated.

The suggestion that bloat is due to nervous inhibition of eructation is also supported by the fact that animals may bloat to varying degrees and that eructation does occur even when the animal is bloated.

Injection of atropine (parasympathetic inhibitor) and epinephrine (sympathetic stimulant) have been demonstrated to produce varying degrees of bloat in sheep and cattle. Studies designed to investigate the possible relationships between the nervous inhibition of eructation and the bloat which occurs in ruminants feeding on green legumes or on certain high-concentrate diets have been conducted.

When compared to green non-legumes, which are much less likely to cause bloat, legumes are usually high in protein and the tyrosine content is proportionately high. Artificial bloat has been produced by replacing epinephrine injections with orally administered L-tyrosine or tyramine which could be present in the rumina of naturally bloated animals as the result of microbial decarboxylation of tyrosine.

If atropine and epinephrine or components of feedstuffs which lead to similar effects can cause bloat, it might be expected that factors which counteract these drugs could prevent or relieve bloat. Priscoline (tolazoline hydrochloride U.S.P., CIBA) and Serpasil (reserpine, CIBA) which would be expected to stimulate the parasympathetic and dampen the sympathetic nervous system have been used to counteract the effects of atropine and epinephrine.

Both priscoline and serpasil appre-

ciably reduced the incidence of bloat in sheep fed on green alfalfa while injections of atropine and epinephrine increased the incidence and severity of bloat in such animals. Injections of priscoline resulted in a more rapid relief of bloat resulting from alfalfa or drug injections. Priscoline has also been shown to prevent bloat in sheep drenched with L-tyrosine or tyrosine and injected with atropine and it has

prevented bloat in sheep self-fed on a feed lot "bloat" diet.

In these studies, salts of calcium, magnesium, or sodium administered as drenches were not effective in influencing the incidence or severity of bloat. These salts were also administered to sheep on a bloat diet; and no significant difference could be observed between the treated and untreated animals.

Project GC-45

Cottonseed Meal and Fish Meal Combined to Supplement Swine Rations

Although cottonseed meal is high in protein, its use as a protein supplement to swine rations has been limited, due to the presence of free gossypol. Toxic levels of gossypol in a swine diet resulted in retarded growth and reduced feed efficiency. In severe cases of gossypol toxicity, death is the result of feeding cottonseed meal that contains free gossypol. Recent improvements in cottonseed meal processing have produced higher quality meals with reduced levels of gossypol. More attention to quality control in the fish meal industry in recent years has also resulted in the production of higher quality meals. Experiments have been conducted to evaluate cottonseed meal of known amino acid and gossypol content as the only protein supplement to swine diets or in combination with fish meal.

Hampshire — Yorkshire crossbred pigs were fed corn-cottonseed meal diets containing initial crude protein levels of 16, 15, and 14 percent and with 0, 2, and 4 percent of the total crude protein supplied by menhaden fish meal. All diets were adequately supplemented with vitamins and minerals. The total crude protein in all diets was reduced

2 percent when the pigs reached a weight of 125 pounds. When each pig reached approximately 200 pounds, it was removed from the experiment, and carcass measurements were taken at slaughter.

Unsatisfactory gains and feed efficiencies were observed in pigs fed diets with cottonseed meal as the only protein supplement. However, no clear symptoms of gossypol toxicity were noted. The free gossypol content of the cottonseed meal was 0.03 percent.

Pigs gained significantly faster and more efficiently when 4 percent of the crude protein was supplied by menhaden fish meal. The gains and feed efficiencies of pigs fed diets with 2 percent of the crude protein from fish meal were somewhat lower than for pigs fed diets with higher fish meal supplementation, but generally better than for pigs receiving diets with no supplemental fish meal.

Although the faster-gaining pigs which were fed diets containing fish meal showed more backfat thickness, the yield of lean cuts was not significantly lowered and larger loin eye areas were observed at the higher level of

supplementation. Taste tests indicated that no fish flavor was imparted to the pork as a result of feeding the levels

of fish meal employed in these trials.

Project C-33



Interior of farrowing wing. New swine facilities provide for individual penning of each litter and uniform environment to provide good control on suckling pig experiments.

Influence of Fish Oil On Pork Flavor Tested

The use of fish meal as the sole supplemental protein in swine diets is known to produce pork that has a fish flavor. Available evidence indicates that the oil fraction of fish meal contains most of the fish flavor and that deposition of this oil in the pork carcass imparts the flavor to pork. However, there is not sufficient evidence available to establish the maximum level of fish oil that may be present in a swine diet which will allow the production of pork free of a "fishy" taste.

Pigs are being fed diets with various levels of added fish oil. Data is being

collected on the daily consumption as well as the total consumption of fish oil during the feeding period. These pigs will be slaughtered when they reach market weight; and pork and fat samples will be taken at that time. In addition to taste-panel evaluation of the pork, a chemical method to detect fish flavor will be studied.

These studies should provide necessary information to establish the level of fish meal that may be used in swine diets without producing pork of objectionable flavor.

Project C-33



Exterior barn picture. Recently completed swine facilities at Queenstown include a farrowing wing (right), a feeding barn (left) and feed handling and storage (center).



Interior of feeding barn. Two hundred pigs can be fed in 40 pens of 5 pigs each in the feeding barn at new swine facilities.

New Approach to Protein Requirements in Swine Feed

The protein requirements presently used to formulate swine diets are based on full feed consumption, which is controlled by the pig's appetite. The current consumer preference for leaner pork has stimulated interest in developing methods that will produce a leaner pork carcass. One method that has attracted considerable interest is the limitation of feed consumption which has been shown to result in greater feed efficiency and leaner pork carcasses. This trend has suggested the desirability of re-evaluating the protein requirements of swine when fed a limited ration of corn and soybean oil meal supplemented with vitamins and minerals.

Growing pigs are being full-fed to a weight of 100 pounds with diets containing various levels of crude protein. At that time full feeding is discontinued and the pigs are restricted to 75 or 85 percent of estimated full feed consumption. Again, various levels of crude protein are fed at the two feeding levels. The performance of the pigs on



Nursery for little pigs. Baby pigs are isolated immediately at birth

these various feeding programs is evaluated on the basis of growth rate, efficiency of feed utilization, and the production of lean wholesale cuts of pork. The results of these studies should provide more accurate information for protein requirements of swine on a program of limited feeding.

Project C-35



New feeding barn for cattle.

BREEDING

Establishment of a New Herd for Research on Beef Cattle

The "B" herd at Wye Plantation, Queenstown, Maryland is in the initial stages of formation. Between 20 and 30 Angus calves of the 1963 crop, resulting from selected matings within the "Wye" herd, are being individually fed on gain-test trials. Forty to fifty calves are expected for the 1964 crop. Basic weight, measurement, and other data are being obtained on all animals.

Sufficient information has not yet been obtained to warrant summarizations.

New physical facilities, in addition to the barns for individual feeding (42 head), include the remodeling of a barn into a weighing, measuring, and office building; the construction of new fences and corrals; and the assignment of pastures for the use of the new herd.

Project C-39

Bodily Measurements and Carcass Values of Beef Cattle

Preliminary analyses of data are indicating that a simple method for the determination of the fatness of cattle may be possible, that parts of the body not associated directly with a wholesale cut may be of more importance in estimating the weight of a cut than measurements taken at the site of the cut itself, that parts of the body usual-

ly not noted when judging an animal may be of significance in estimating the yield of wholesale cuts, and that frequently "straight line" measurements taken by use of a caliper or steel tape are of more value than the much more laboriously obtained contour measurements.

Project C-40

BOTANY

The Botany Department provides for studies on the fundamental nature of plants—their classification, structure, genetics, physiology, and biochemistry. Research activities of the department include many topics of interest to practical agriculture, and its scientific publications add to the store of basic information that is improving our understanding of the living organisms. Investigations center on higher plant species as well as the micro-organisms which may aid in their growth or threaten their survival.

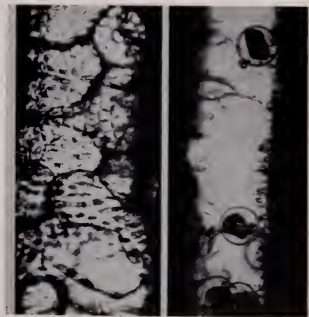
Resistance of Sweet Potato to Fusarium Wilt

A study was made of the basis for resistance of the foreign plant introduction "Tinian" (P.I. 153655). Histological examinations of serial stem sections of the susceptible sweet potato variety Porto Rico and of the resistant foreign plant introduction "Tinian" were made from plants collected at 3-day intervals following inoculation with spores of the pathogen. It was found that "Tinian" responded to infection by the production of tyloses in advance of the fungus.

Twelve days after inoculation, 75-88% of the vessels which were 22 - 32 mm above the invasion site at the base of the plant were completely filled with tyloses. This compared to only 0 - 3% in the uninoculated control plants. Furthermore, no mycelia or spores could be detected in this region but they were present in 25 - 50% of the vessels within 11 mm of the invasion site. In the variety Porto Rico the occurrence of tyloses in the inoculated plants was not significantly greater

than in the uninoculated controls, except near the invasion site, where after 12 days 3-6% of the vessels contained small tyloses. The pathogen was not limited, as in "Tinian", to the immediate invasion site. This suggests that the production of tyloses in "Tinian" may represent an important defense mechanism against Fusarium wilt.

Project J-100



Blocking the wilt of sweet potatoes. Left — Vascular bundle of sweet potato completely occluded by tyloses in the vessel of a resistant "Tinian" strain of sweet potato. The tyloses form an almost solid growth that effectively blocks the spread of Fusarium wilt and allows the production of plants of food value. Right — Vessel of the Porto Rico variety produces only an ineffective tylosis formation, which does not halt the disease. Therefore the commercially important Porto Rico may sometimes suffer losses up to 100 percent.

Progress of Manual of Woody Plants of Maryland

Additional specimens are being added to the station herbarium. Travel in certain counties has improved our knowledge of the natural vegetation therein. Progress is being made in the basic information for a manual of the Woody Plants of Maryland.

Current use of this information and specimens is made in the identification of the many specimens of trees, shrubs, and wild flowers, including weeds and poisonous plants, received from Maryland residents.

Project F-12

Tobacco Mosaic Losses in Best Tobacco Grades

After four years' testing the effects of TMV on tobacco inoculated at 2-week intervals during the growing season, indications are that heavy losses in weight and dollars per acre occur in most grower grades. Losses are heaviest when the plants are inoculated during the first 6 weeks. Heaviest losses occur when tobacco is inoculated at transplanting time.

Approximately 50 percent of the losses occur in the Bright Crop tobacco. The other 50 percent is distributed over the Seconds, Dull-bright and Dull crop leaves. The tips had an actual gain in pounds per acre by a value loss of 2 cents a pound offset the gain in weight considerably. The earlier the infection takes place, the greater are

the losses. Some losses occur when the plants are inoculated 10 days before harvest.

Project J-98



Mosaic disease cuts yield of tobacco in row on right.

Control of Diseases of Ornamentals and Turf Grasses

Research during the past year has confirmed that *Helminthosporium tetramera* and *Rhizoctonia solani* can cause serious root and crown rots of Meyer-52 Zoysia grass. Two previously undescribed pathogens have also been found causing diseases of Zoysia. A nematode, similar to *Meloidogyna* sp., has been identified as the cause of poor stands and dead spots in both private and commercial Zoysia plantings during the summer of 1963 and has since

been found to cause similar symptoms on Bermudagrass. This nematode has recently been placed in the new genus *Hypsoerine* (Sledge and Golden, 1964.)

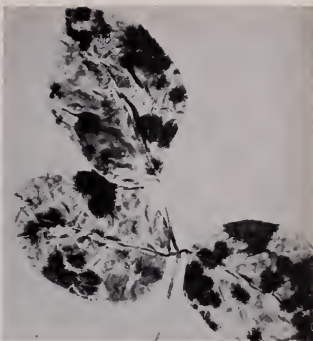
A new fungal pathogen of Zoysia, first found in 1962, has been identified as an unnamed species of *Helminthosporium*. Fungicide and nematocide trials were conducted on both Merion Bluegrass and Meyer-25 Zoysia grass. Tersan OM and Dyrene were the most

effective broad-spectrum fungicides on both grasses. Nemagon gave 80% nematode control but was inferior to the numbered nematocide, Bayer 25141.

A fasciation disease of snapdragon was found in a large commercial planting. The symptoms were similar to those caused by the bacterium, *Corynebacterium fascians*, on carnation, geranium, petunia, and sweetpea. Snapdragon is not a recorded host of this pathogen. Several bacterial isolates from diseased snapdragons and a isolate of *C. fascians* from a fasciated geranium plant are being used to inoculate various plant species in order to confirm the identity of the snapdragon pathogen.

Dahlia tubers were inoculated with either *Erwinia caratovora* or *Botrytis cinerea* within 48 hours after they were removed from the soil. Both of these organisms cause storage rots of dahlia tubers. The tubers were buried in containers filled with either sand or vermiculite and were stored throughout the winter at constant temperatures of 40 or 60° F. Spot checks throughout the winter indicate little rot development in any of the treatments. The storage techniques will be further evaluated when the tubers are removed from storage and planted.

Seven hundred rose plants (one half, the variety Duet and the other half, the variety Radiance) were sprayed weekly throughout the summer with the fungicide, Folpet. Starting dates,



Black spot of rose caused by *Diplocarpon Rosae*.

termination dates, and rates of fungicide application were varied to determine the best spray combination for the control of blackspot, caused by the fungus *Diplocarpon rosae*. Little difference in blackspot severity could be distinguished among plants having different starting dates of fungicide application; possibly because of the slow development of the disease during the dry summer of 1963. Moderate to heavy late-fall infection occurred, however, in plots where fungicide application was terminated September 16. One and one-half pounds of 75% wettable powder in 100 gallons of water was the most effective rate of application.

Project J-99

New Fungus Found on Mosses and Algae

Fungus diseases of mosses and algae are not commonly found; although fungus diseases on species of both the lower plant forms are known to occur, it is rarely if ever that they are attacked and killed by the same fungus. It is

still more unusual when a soil-borne fungus in the genus *Rhizoctonia* is found parasitizing algae and mosses. The imperfect stage of the fungus is typically a *Rhizoctonia*. Isolations on culture media, produced the perfect

stage. Basidia in the form of a crozier was found to produce basidiospores in all culture media supporting growth of the fungus. Because of the type of basidia formed, the fungus has been transferred to the genus *Helicobasidium* and it is a new species of this genus.

After 3 years searching, the perfect stage has not been found occurring in nature. It has been found on culture media, sterile soil, and sterile potato peeling.

Host range studies indicate that the unusual fungus will attack 20 species of mosses, several algae, tomato, potato, tobacco, several grasses, liverworts and ferns, and it has killed pine tree seedlings. The fungus attacks species of all the major plant forms except fungi themselves. The host range of this fungus is probably the most varied of any fungus known.

Project J-93

Triple Resistance to Three Root Rots of Tobacco

To produce a Maryland type tobacco resistant to the three major root rots, crosses were made between Maryland Catterton and Mor 59 black shank-resistant tobacco. The above cross should also produce more pounds of tobacco per acre. Catterton was used as the female parent and Mor 59 as the male parent. Since Catterton

and Mor 59 have some resistance to black root rot and fusarium wilt it was expected that the cross would show resistance to these diseases. Results of indexing confirm this. The F_2 of the Catterton-Mor 59 cross showed 20 percent of the selections made from the field had 70-100 percent resistance to black shank; 64 percent of the selec-



Two new tobacco varieties, the first two ever developed in the 300 years of Maryland history. Left, Maryland 59. Right, Maryland 609.

tions had 70-100 percent resistance to black root rot and 90 percent resistance to fusarium wilt.

A backcross between the Catterton \times Mor 59 cross with Mor 59 as female parent shows an increase of black shank resistance. The F_1 generation shows 32 percent of the selections had

70-100 percent resistance to black shank, 80 percent had 70-100 percent resistance to black root rot, and 75 percent had 70-100 percent resistance to fusarium wilt. As selections are made in future generations, resistance to the three diseases should increase.

Project J-95



Eurasian milfoil, a new invader, spreading over thousands of acres of Chesapeake Bay and tributaries, fowling propellers, harvesters, and fishing tackle. It is being analyzed for possible feed and fertilizer values.

Eurasian Water Milfoil

Myriophyllum spicatum in a period of 3 years invaded over 100,000 acres of the Chesapeake Bay and its tributaries. In severely infested areas, boating, fishing, swimming and crabbing were seriously impaired if not stopped altogether. Other states report an increase in the mosquito population under similar circumstances. This invader from Europe not only thrives in fresh-water ponds but also in water with up to 17 ppt of salt. Potentially it could be a major problem in ponds and streams used by farmers for a multitude of purposes.

Research here in the Botany Depart-

ment has shown that a new plant can regenerate from a piece of stem only 22 mm long if a leaf is present on the piece. Hence any program to eradicate it must be all-inclusive. On the other hand, little was known of its mineral composition. Could it be used as a green manure, a source of feed, a feed supplement? If so, how much of a yield could be expected per acre? In the 6 months this project has been in effect the results indicate a relatively low N-P-K content. However no firm conclusion can be drawn in this short a time.

Project F-19

Pollen Collected to Substantiate Classification

During the past year pollen was collected from Albizzia trees which had developed from twin seedlings. Since pollen viability is related to the degree of polyploidy, as is stomata size, this method was being used to substantiate classification previously determined by stomatal size. All of the plants which

flowered this past year proved to have 90% or more viable pollen, hence could be considered diploids. Plants with unusually large or small stomata were put on a longer photoperiod, in order to induce earlier flowering in the greenhouse.

Project F-17

Physiology and Culturing of Plant Nematodes

Investigations have continued on the influence of plant growth substances on the reproduction of nematodes on alfalfa tissue cultures. 2,4-Dichlorophenoxyacetic acid (2,4-D) plus Kinetin (K) added to the basal mineral-sucrose-vitamin agar medium continued to give best reproduction of *Ditylenchus dipsaci*, although it was only about 20% better than 2,4-D added alone. Kinetin in all combinations inhibited reproduction of *Pratylenchus penetrans* while it had little effect on the related species *P. zeae*. Both *P. penetrans* and *P. zeae* reproduced best on basal medium containing only added 2,4-D. Such studies are providing information on nematode nutritional requirements.

Studies on alfalfa galls caused by *D. dipsaci* have revealed that the nematode causes little change in pectins in 7-day-old galled alfalfa seedlings, and no free galacturonic acid or polygalacturonase activity could be detected from tissue preparations. Studies on the nematode polygalacturonase have indicated that 1) intact worms will secrete the enzyme into solution, 2) ions are needed for activity and 3) the enzyme breaks pectin down to galacturonic acid *in vitro*. These studies are elucidating the mechanism of disease production

by the stem and bulb nematode in alfalfa.

Project J-97(NE-34)



Lane nematodes; *Hoplolaimus* sp., male and female.

Fungicidal Materials for Field Control of Vegetable Diseases

A study of the mechanism of action of the antibiotic cycloheximide indicated that it affects a specific reaction

in protein synthesis, probably the polymerization of amino acids into protein. A fungitoxic compound (a phenolic

acid) was isolated from lima bean plants resistant to downy mildew.

Several fungicides were evaluated for control of diseases of tomato, cantaloupe and cucumber. The maneb fungicides continued to be the most effective for controlling diseases of tomato. It was also effective in controlling diseases of fall-planted cucumbers, but is not recommended for spring-planted cucumbers because of phytotoxicity. Phal-

tan used with a sticker was effective in controlling cantaloupe diseases.

Studies of the mechanism of action of toxicants and the identification of compounds responsible for disease resistance in plants should aid in the development of more effective toxicants. Field tests provide a basis for recommending the most effective fungicide program for disease control.

Project J-91

Boron Required by a Selaginella and a True Fern

Selaginella apoda and a fern, *Dryopteris dentata*, required boron for the completion of their life cycles. In its absence, the terminal growing points of the fern died and very few sori (which bear the sporangia and spores) were produced. The few sori, which were produced by boron-deficient fern plants, did not have a covering, or indusium, over the sporangia. The spores appeared to be devoid of contents. The few strobili, which boron-deficient *Selaginella* plants formed, were aborted and very abnormal in appearance.

Three unicellular species of algae were studied with respect to boron requirement: *Chlorella vulgaris*, *C. py-*

renoidosa, and *C. protothecoides*. On the basis of growth rates (number of doublings of cell numbers per day), there was no statistically-significant difference in growth rates whether the algae received 0, 0.01, 0.1, 1, 10, or 20 ppm of boron.

These findings are of interest in connection with the theory that boron is involved in the translocation of sugars in plants. Boron was not required for the unicellular algae, in which there is no sugar translocation, but it was required in *Selaginella* and the true fern in which there is a translocation of sugar.

Project K-8-e

Corn Used in Study of Inheritance

Corn is an exceptionally well-adapted plant for applied and basic studies of inheritance. A large number of mutations have been accumulated, and these serve as useful tags or markers for determining the genetic contributions of the male and female parents to the offspring.

X-rays are known to cause breakage of chromosomes, with accompanying loss of genes governing inheritance. X-ray-induced losses can be detected in the offspring if one parent carries the normal genes and the other parent has the corresponding marker mutations. A study was designed to ascertain if the loss of genes in a chromosome of

corn affected the normal behavior of other chromosomes during the divisions leading to the formation of the sex cells. Approximately 10,000 kernels were obtained following crosses utilizing X-rayed normal pollen applied to female parents carrying recessive marker mutations in chromosome 1.

Plants exhibiting losses of normal dominant genes have been isolated. The pollen mother cells of the deficient plants will be studied microscopically to determine if deficiencies in chromosome 1 affect the normal association of all chromosomes required for sexual fertility.

Project F-18

DAIRY SCIENCE

Objectives of the research program in the Department of Dairy Science are to provide new knowledge, which when applied in the industry, will increase the efficiency of the production and utilization of milk and dairy products. Results of some projects are such that they are applied immediately. There are continuous improvements in the industry as a result of these applications. Other work results in improved understanding of fundamental principles involved in animal production and the chemistry of milk. Facts of a fundamental nature provide a foundation for the continued growth and development of the industry.

Effects of Mild Alkaline Salts on Ice Cream Properties

Usefulness of mild alkaline salts in influencing the characteristics of ice cream and soft-serve products has been studied recently. The salts included calcium oxide, magnesium oxide, calcium hydroxide and magnesium hydroxide.

Results of the study showed that the addition of mild alkaline salts affected the dryness and stiffness of the product. Calcium salts were more effective in producing dryness and stiffness; magnesium salts were more effective in producing glossiness. There was an improvement in the flavor score upon the addition of the alkaline salts, especially at the 0.02 percent level of the calcium salts, and in the body and texture scores at the 0.02 and 0.04 percent levels for these salts. An ingredient flavor prevailed in varying but not objectionable degrees when the 0.06 percent level was used.

The ice cream containing 0.02 percent calcium hydroxide and the one containing 0.02 percent calcium oxide ranked highest in flavor score. The body-and-texture score also was highest for these products. Included were products in which 0.02 and 0.04 percent of calcium hydroxide and calcium oxide and 0.02 and 0.04 percent of magnesium hydroxide were used.

Results showed the addition of mild alkaline salts affected the properties of the soft-serve product in a manner similar to the effects observed for the ice cream.

The beneficial effects on the flavor, body-and-texture and handling characteristics of the products studied, resulting from the use of mineral salts at the 0.02 and 0.04 percent levels, as compared to the control, were evident to the professional observer, and to others as well.

Project G-42

Curd Tensions and Cottage Cheese Production

Investigations were initiated to utilize curd tension as the sole basis for cutting cottage cheese curd. Perfection of such

a method would eliminate the use of acidity measurements in the manufacturing method.

Skim milk at three levels (9, 10 and 11%) nonfat dry milk solids was used in the study.

Data show that pH and acidity cannot be effectively used as measurement criteria for establishing the cutting time of cottage cheese unless rather complete history of the skim milk, culture and coagulator is known. Curd tension seems to be a better indicator of the conditions of the curd at all times during the coagulation period.

Results show that cottage cheese curd made with 9, 10 and 11 percent nonfat dry milk solids should be cut at curd tensions of 40 to 70 g., 40 to 60 g and 40 to 50 g, respectively. Storage life of these cheeses was greater than 21 days. When the curd was cut below 40 g, dry and grainy cottage cheese developed, whereas cutting above 80 g resulted in products with high moisture and poor keeping quality.

Project G-53



How the cow converts forage and grain to the constituents of milk is studied by scientists in the Dairy Science Department. The products available to the udder are separated and examined to learn which are most important.

Method for Predicting Oxidized Flavor in Milk

A rapid method for evaluating the oxidative stability of milk fat globules in a model system gave results highly correlated with the susceptibility of the original milk to develop oxidized flavor. Results are available within 3 hours after collecting a 1-liter sample of milk, as compared with two or more days normally required for evaluation. A similar method for evaluating the antioxidant properties of milk is under study. Preliminary results indicate that citric acid plays a major role as an antioxidant in milk.

Related studies showed that fat glob-

ule membrane material (FGMM) depleted of copper, by a chelating agent, did not undergo lipid oxidation when ascorbic acid was added. Activity was restored to the system when copper was added, thus demonstrating the key role of copper in this reaction.

Evidence indicating a specific structural configuration in the FGMM between protein-copper-lipid was obtained from studying the effects of homogenization on the rate of reaction between FGMM and ascorbic acid.

Project G-34

Feed Can Affect Acid Composition of Milk Fat

Analysis of the fatty acid composition of milk fats from cows on various feeding regimes has indicated that there is a definite trend toward production of more saturated milk fat as the propor-

tion of roughage in the ration is increased. Milk fat samples from a group of six cows, feeding on corn silage free choice, plus 9 pounds of 32% protein supplement per day per cow, contained

87% saturated fatty acids. Other feeding regimes, composed of various levels of hay and grain, yielded milk fat containing 65% saturated acids (high grain ration) and 78% saturated acids (high hay ration). The variations in the composition of milk fat as a function of some commonly used feeding regimes is evidently larger than previously realized.

Variations of this magnitude may affect the properties of many dairy products. Differences in dairy product properties (i.e., hard versus soft butter) may be reflective of differences in feed. It is suggested that the type of milk fat produced on a certain feeding regime should be one of the important parameters in evaluating the feed.

Project G-48



Feeds for dairy cattle are examined by a graduate student in Dairy Science to determine their usefulness for milk production.

Clues to Origin of Some Milk Fat Components in Rumen Microbia Lipids

Previous reports from this station have suggested that the unique branched-chain fatty acids and aldehydes found in milk fat originate from rumen bacterial lipid synthesis. Further support for the concept that significant components of milk and ruminant carcass fats originate from bacterial lipid has been obtained from study of the positions of the double bonds in the unsaturated fatty acids of various fats. The octadecenoic acid fractions were isolated from olive oil, lard, beef fat, milk fat, and rumen bacterial fat. The positions of the double bonds in these fractions were determined. The fraction from olive oil was pure *cis*-9-octadecenoic acid. The lard fraction contained 95% *cis*-9-octadecenoic acid and 5% *cis*-11-octadecenoic acid. The fractions from beef fat and milk fat were very similar, and contained 87%

9-octadecenoic acid and 13% of a complex mixture of isomers, with double bonds in each of the positions from C_7 to C_{14} . The fractions from rumen bacteria contained isomers with double bonds in the C_4 to C_{14} positions. The major isomers were 36% 9-octadecenoic acid and 53% 11-octadecenoic acid. Further fractionation of the bacterial acids demonstrated that the *cis* isomers were primarily composed of equal parts of 9 and 11-octadecenoic acids with traces of acids with double bonds in the C_7 , C_8 , C_{10} , and C_{12} positions. The bacterial *trans* acid fraction contained 81% 11-octadecenoic acid and small quantities of acids with double bonds in positions C_8 to C_{15} . The conclusion from this comparative analysis is that 10-15% of the unsaturated fatty acids of ruminant fats originate from acids synthesized by rumen microbes. *Project G-48*

Flavor Compounds in Cheese



Ripened and unripened Cheddar cheeses were analyzed for monocarbonyl compounds. The total amount of these compounds was higher in the ripened than in the unripened cheeses. No conclusions could be reached on the development of the individual monocarbonyl compounds during ripening, since the general trend in changes in their concentration did not exist. The study did reflect changes in microbial population and metabolic conditions in the cheeses.

The monocarbonyl compounds isolated consisted of saturated and unsaturated, straight and branched chain aldehydes and ketones. Dicarbonyl compounds were also present but were not measured in the investigation.

(G-35)

Flavor of all dairy products is important in their use as foods. Here a graduate student in Dairy Science conducts one stage of the research necessary to isolate and identify flavor compounds.

Mineral Supplements and Freezing Point of Milk

Some doubt has been expressed of the use of the freezing point of milk as a means of detecting abnormal milks. This study was designed to observe the effects of feeding various mineral supplements (sodium chloride, potassium bicarbonate, limestone, and defluorinated rock phosphate) on the freezing point of milk.

The average freezing point range for all animals in the study was 0.537°C

to 0.566°C , with an average freezing point for all milk of 0.542°C . Wide variations in the freezing point of milk of individual animals occurred during the test period; however, such individual variations did not follow any definite pattern. Data substantiated the concept that herd milks have a relatively constant freezing point regardless of mineral supplementation.

Project G-35

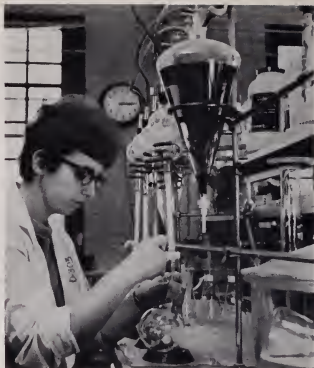
Osmotic Relationship Between Milk and Blood

Freezing point determinations were made to study the osmotic constancy between the secreted milk and whole

blood, blood plasma, and blood serum of the dairy cow. Blood samples were taken from the jugular vein before and

after milking. Correlation analyses of freezing point data show that an osmotic relation exists between milk and whole blood and milk and blood plasma. No such relationship was observed for milk and blood serum.

The osmotic pressure of whole blood and the blood fractions of individual animals was consistently higher than that of the secreted milk, although the differences were relatively small. Rather marked differences in osmotic pressure between fluids from individual animals were noted. *Project G-35*



A dairy scientist examines a plate on which the different parts of milk fat are separated. Results of this research will show more clearly how milk contributes to the nutrition and health of consumers.

Feeding of Carbonates Prevents Low Fat Test

In studying the possible causes of milk-fat depression when cows are pastured on pearl millet, either potassium bicarbonate or magnesium carbonate were supplemented in the concentrate mixtures of cows grazing pearl millet or Sudangrass pastures. Carbonates have been shown to return fat content of milk to near normal levels with high grain-low roughage rations; however, in this study the supplements did not

affect the composition of the milk.

Cows grazing pearl millet had a lower fat test, 2.85% vs. 3.64%, than those on Sudangrass. Analysis of rumen samples showed cows on pearl millet had a lower molar percent of acetic acid, butyric acid, and isovaleric acid and a higher percent of propionic and n-valeric acid than those on Sudangrass.

Project 1962 - BG-2

Nutritive Evaluation of Forages

Intake and digestion trials were conducted with alfalfa harvested on May 17 and June 14 and each fed in the long and the pelleted form to milking cows, yearling heifers, 10-20 week old calves, and yearling wethers. The pellets depressed digestibility but increased intake with the exception that the intake rate was not affected with the

milking cows. The digestion coefficients for the calves were lower than for the other groups. Intake rates varied significantly among groups when calculated either on an intake per 100 lbs body weight or intake per 100 lbs body weight^(.75). The calves were the highest and the yearlings the lowest when calculated on a basis of intake per 100

lbs. The cows were highest and the sheep the lowest when based on body weight ^(.75). Nutritive value indices were calculated and did not rank the four types of hay the same for each group of animals.

Digestibility studies were conducted on two varieties of alfalfa (Dupuit and Williamsburg) and two varieties of orchardgrass (S-37 and Potomac), all harvested on the same date. Williamsburg was about one percentage unit

higher in dry matter digestibility than the Dupuit, and the S-37 was about 3.5 percentage units higher than the Potomac orchardgrass.

The regression of dry matter digestibility on date of harvest was calculated, using data collected over the last 6 years. The equation was $Y=68.4-0.32 X$ where Y is equal to dry matter digestibility and X is equal to the number of days from April 30 to harvest date.

Project G-47

Nitrogen Fertilization of Grass Pastures

The 1962 grazing season was the last year for the comparison of three levels of nitrogen (100, 200, 300 lbs per acre) on orchardgrass compared with orchardgrass-Ladino and Midland Bermudagrass pasture. In addition, sod-seeded cereal rye was seeded in Midland Bermudagrass to extend the grazing season of the Bermudagrass. The production of all pastures was much lower than during previous seasons because of a severe drought. The relative carrying capacities were about the same as during previous years, with the added nitrogen increasing the carrying capacity

over the orchardgrass-Ladino treatment. As during previous seasons, the results indicate little or no advantage of 300 lbs nitrogen over the 200-lbs level.

The Midland Bermuda with sod-seeded cereal rye produced the greatest carrying capacity and continues to show promise as a good-quality pasture, as well as one having high production per acre when managed properly. During the drought the Midland Bermudagrass continued to produce some forage even though production was much lower than for the two previous seasons.

Project BG-1

Corn Silage as the Only Forage

A three-year study has shown that corn silage is highly satisfactory as the sole forage for lactating dairy cows during the winter feeding period, when it is properly supplemented with protein. There was no significant difference in the feeding value of silage produced from fields heavily fertilized with nitrogen (200 lb N./A.) and silage from fields not fertilized with nitrogen. Neith-

er was there a difference in the vitamin A content of the milks produced. On the basis of this study, feeding corn silage as the sole forage during the barn feeding period can be recommended when it is economically advisable. Further studies will be conducted in which corn silage will be fed as the sole forage during several successive lactations.

Project G-52

Abomasal Fistula in Left Para-Lumbar Fossae of Calves

Previous methods of fistulating the abomasum of calves involve a right ventral flank incision or a right ventral thoracic incision. The usual problems are leakage of abomasal contents from the fistula and an inability to feed the calf via fistula.

Excellent results were obtained by establishing the fistula high in the left

para-lumbar fossae in 1-week-old calves. No leakage has occurred and gravity feeding has been possible. However, considerable displacement of the abomasum occurs which would be a disadvantage in certain types of studies.

Project G-39

Abomasal Feeding, Glycemia and Forestomach Development in the Calf

Abomasal fistulas were placed in calves at 1 week of age. The calves were then fed according to three different feeding regimes, with one group of 4 calves receiving all of their solid food by fistula, in order to determine the influence of abomasal feeding on forestomach development and the role of the forestomach in digestion and metabolism.

Marked differences occurred in fore-

stomach development with the abomasallyfed calves having purple colored forestomachs with underdeveloped pillars and papillae compared to the control calves. However, no significant differences, $P < .05$, occurred in glycemia (blood glucose level) or total blood organic acid levels between groups in the 90-day experiment.

Project G-39, GC-45

Metabolizable Energy for Milk Production

The efficiency by which metabolizable energy was converted to milk increased significantly as concentrates replaced hay in lactation experiments carried out cooperating with the U. S. D. A. Energy Metabolism Laboratory at Beltsville, Maryland, even though the metabolizable energy intakes of the three rations studied were

equal. The increase in efficiency is thought to result from changes in the molar percentages of the volatile fatty acids produced in the rumen as concentrates replaced hay, because a significant reduction in the ruminal concentrations of acetic acid occurred.

Project G-39

Tissue Distribution of Radioactive Carbon Labeled Progesterone

Studies of the tissue uptake and distribution of progesterone, as determined by autoradiographic techniques, were described in the previous annual report. These studies have now been extended to determine the uptake and distribution at various time intervals to allow deductions to be made as to the nature

of the biochemical processes occurring. The rate of renewal of progesterone appears to be 20 minutes or longer, and it appears that the ovarian rate is limiting. Chemical fractionations are being carried out to confirm these conclusions.

Project G-50

Progesterone Excretion in Dairy Cattle

Knowledge of the route of excretion of progesterone is important to an understanding of the action of progesterone in cattle. Previous work reported here last year, indicated that large amounts of progesterone appear in the lactating mammary gland. This finding suggested that milk might serve as an important route of excretion. Using radioactive progesterone administered to a lactating cow, it was determined

that in the 72 hours after administration, 3% of the progesterone was lost in the urine, 50% was excreted in the feces and less than 1% appeared in the milk. Milk then is not an important route for progesterone excretion, and thus, is not likely to contain significant amounts of progesterone or its metabolites.

Project G-50

Labeled Palmitate Metabolism in Ruminant Liver

Radioactively labeled palmitate has been used to study fatty acid metabolism by perfused goat livers. Information of basic importance has been obtained concerning fatty acid metabolism by the liver. In dairy cattle, previous work in these projects has shown that as much as 25% of the acetate metabolized arises within the animal. This study has shown that much of this may be produced by the liver from long-chain fatty acid. Data are available to indicate the importance of normal levels of ketone bodies in ruminants and in nonruminants.

The importance of abnormal levels is known from such diseases as diabetes and ketosis. The present study of liver metabolism has shown that significant quantities of ketone bodies are synthesized in the ruminant liver from long-chain fatty acids. This was found to be true regardless of the amounts of short-chain fatty acids present. The radioactive labeling in the ketone body has indicated various possibilities for the biochemical pathways followed in this synthesis.

Project G-37, G-46

Growth Hormone Effects on Metabolism of Fatty Acids

The studies of the regulation of fatty acid metabolism being conducted in this laboratory have been continued. As

was reported last year, growth hormone stimulates acetic acid metabolism about 25 percent. It was suspected that this

was due to effects on the metabolism of long-chain fatty acids. Growth hormone effects on long-chain fatty acid metabolism are now being investigated. (See illustration on page VI). Initial data indicate that growth hormone treatment results in an increased blood plasma concentration of free fatty acids. This work is being continued to determine whether free fatty acid

composition is altered. It has been shown that ruminant liver metabolizes long-chain fatty acids to blood acetic acid in an artificial heart-lung perfusion system. This may account for the extra acetic acid metabolized in the animal treated with growth hormone. Growth hormone did not affect fatty acid metabolism in the isolated liver.

Project G-46

Long Chain Free Fatty Acids in Bovine Blood

In the last few years, the importance of minor amounts of free fatty acids present in blood has been demonstrated. Concentration of such acids has not previously been measured in any significant number of dairy cattle. Determinations were carried out on a total of 22 dairy cows and the mean

free fatty acid concentration of blood plasma was found to be 0.34 ± 0.08 milliequivalents per liter. This is similar to the concentrations reported in other species, including man. No difference was found between Jersey and Holstein cattle.

Project G-46

Glucose Metabolism in the Dairy Cow

The studies of glucose metabolism in the cow have been continued. A variety of basic measurements of glucose metabolism have been carried out. It has been found that dry, open dairy cows contain 70-90 grams of glucose, which is renewed about every $1\frac{1}{2}$ - 2 hours. This glucose has been found to

be distributed in about 20% of the animal's body. Most glucose in cattle and other ruminants must be synthesized in the liver. The finding that increasing the available acetic acid spares the metabolism of glucose by 20-25% is therefore highly important.

Project G-46

Hypoglycemia in the Calf Studied by Hemodialysis

The fetal red-blood cells of ruminants have been shown by some workers to have a greater affinity for glucose than the postnatal red-blood cells. As the ruminant develops, the fetal cells are gradually destroyed and a relative hypoglycemia occurs and continues for the remainder of the ruminant's life. To test this affinity theory, a calf was given an 85% transfusion with dialyzed hypoglycemic cow's blood and then hemodialyzed against a glucose-deficient

bath to challenge the calf further. Although a hypoglycemia level of 10 mg percent was reached during dialysis, compared to the normal 100 mg percent, the blood glucose level returned to normal a few hours after the dialysis was stopped. This indicates that the affinity of red-blood cells for glucose is not a factor in this change in glycemia in ruminants.

Project G-39

Parturient Paresis Syndrome Reproduced in Sheep by Hemodialysis

High-producing dairy cows are prone to parturient paresis, or milk fever, at calving. The syndrome progresses in a few hours from nervous irritability to muscle incoordination, then collapse, usually with skeletal muscle tetany. This is followed by central nervous system depression, coma and death, unless the cow is treated with calcium gluconate, intravenously, to reverse the hypocalcemia. The calcium therapy is usually very effective.

This milk fever syndrome of dairy cows has been simulated in conscious wether sheep by depleting the blood plasma of calcium. One carotid artery and one jugular vein were aseptically catheterized under short-acting general anesthesia (Brevane, sodium methohexitol) just prior to the dialysis. The advantage of the procedure lies in the ability to reproduce the syndrome every time in the laboratory, enabling precise evaluation of the role of calcium in the syndrome. Several sheep have

been revived from a deep depression twice in a 24-hour period by slowly returning the calcium to the system. The cause of death has been observed to be tetany of the intercostal muscles. The electrocardiograph indicates adequate cardiac support of life, 8 to 12 minutes after the last respiration, eliminating the hypercapnic tachycardia and terminal anoxia.

Our work to date on hypocalcemia includes: (1) studies of the changes in gastro-intestinal tract motility (via rumen fistula), (2) skeletal muscle tetany, (3) the electroencephalograph and electrocardiograph, (4) parotid saliva and urine rate of flow and content of calcium, Ca^{45} , P^{32} and $\text{Sr}^{85,89}$. (5) depletion rates and specific activities in the various body pools, (6) bone metabolism and parathyroid function in conscious and anesthetized adult sheep and bovine calves.

Project G-37, G-93, GC-45

Metabolism of Calcium⁴⁵, strontium^{85, 89}, and Phosphorus³² in Calves During Depletion of Elements by Hemodialysis

The metabolism of calcium, strontium, and phosphorus in calves is being studied in cooperative experiments with the University of Tennessee - A.E.C. Agricultural Research Laboratory, Oak Ridge, Tennessee. By dosing calves with each isotope and then hemodialyzing them, the depletion kinetics of each element are being established. The data indicate that calcium is mobilized mainly from a small (30-gram) bone pool reserve located at the epiphyseal and periosteal borders and not in the trabecular regions as

the classical work, mainly with rats, suggests. Strontium⁸⁹ is excreted by the kidneys 17 times as fast as calcium⁴⁵. The concentration of all three elements in the urine decreases as the dialysis continues, as does the volume of urine. Phosphorus³² is not mobilized from the same pools as calcium⁴⁵ or strontium⁸⁹. Whereas, calcium⁴⁵ and strontium⁸⁹ come from the bone, more of the phosphorus comes from the intra-and extra-cellular pools.

Project G-37

Hypomagnesemia and Hypochloremia Produced in Sheep by Hemodialysis

The artificial kidney (Kloff twin coil) is being used to study the specific physiological effects of depleting the blood plasma of conscious sheep of each of the major electrolytes, Na^+ , K^+ , Ca^{++} , Mg^{++} , Cl^- and PO_4^- . With hypomagnesemia, a non-specific acid-

osis suddenly causes death at about 15 hours. With hypochloremia, a critical chloride shift occurs instantly; the sheep may faint, and a terminal alkalosis results. The physiological changes with each syndrome are gradually being established. *Project G-37*

Strontium⁸⁵ Removal from Calves by Hemodialysis

Cooperative experiments carried out at the University of Tennessee - A.E.C. Agricultural Research Laboratory, Oak Ridge, Tennessee, have shown that significant quantities of intravenous dose of strontium⁸⁵ can be removed from calves by hemodialysis if the dialysis is started soon after dosing. The data indicate that more than 20% of the

dose could be removed from the body of calves by dialysis in twelve hours if the dialysis is started two hours after dosing. If the dialysis is delayed to 24 hours, only tracer amounts of strontium⁸⁵ can be obtained by this procedure because of its rapid metabolism. *Project G-37*

Secretion of Calcium by the Parotid Salivary Gland

Sheep with parotid saliva gland cannulas were hemodialyzed with an "artificial kidney" apparatus. The sheep were made hypocalcemic (plasma calcium, 3.5 to 4.5 mg percent) by leaving calcium from the bath solution. The calcium concentration of the saliva decreased to near zero as the dialysis continued, but did not return to normal as rapidly as plasma calcium when

more calcium was infused into the blood stream. The fact that saliva calcium dropped to zero while plasma calcium remained at 4 mg percent indicates that the plasma protein-bound calcium is not available to the saliva gland secretory cells. To our knowledge, this is the first study of the effect of hypocalcemia on exocrine gland secretion. *Project G-39*

Secretion of Saliva in Cattle

Cooperative work with Kansas State University, Manhattan, Kansas, is under way to determine the total secretion of saliva by cattle under different feeding situations. Food boluses are caught in plastic bags as they emerge at the cardia. Between animal and

diet differences in secretion are being determined.

In other experiments bilateral parotid saliva duct cannulas are being used to study the changes in rate of secretion and the composition of parotid gland saliva. *Project GC-45*

Direct Micro-Determination of Calcium

A simple direct micro-method for the calcium content of biological fluids was developed. The procedure has been important in our hemodialysis studies, since the concentration of calcium in the bath solutions after dialyzing a sheep or calf is too low to be accurately quantitated by available

methods. The procedure involves back-titrating the excess sodium ethylenediaminetetracetate with calcium in ultraviolet light. At the endpoint a calcium-indicator complex forms, calcium-calcein, which fluoresces.

Project G-39

General Anesthesia for Sheep and Calves

Brevane, methohexital sodium, has been successfully used for general anesthesia in sheep and calves. To our knowledge, we are the first to use this drug on such animals. The intravenous anesthetic is much shorter acting than any other intravenous anesthetic avail-

able for ruminants. This advantage enables arterial and venous catheterization immediately before a hemodialysis experiment, yet the patient will be completely conscious in 10 minutes for the dialysis.

Project G-39

ENTOMOLOGY

Research is underway to assist growers in the solution of practical problems so that losses caused by insects will be kept to a minimum and products of the highest quality will be obtained. Insect control is often a major cost factor in production. Simultaneously research is conducted to obtain the answers to fundamental questions about insect structure, physiology, biology, and taxonomy.

Dimethoate Now Recommended for Pea Aphid Control

With government approval of dimethoate for use on peas, this material is highly recommended for pea aphid when early infestations occur. Since dimethoate cannot be used later than 21 days before harvest, peas should not be treated later than the full-bloom stage with this material. This insecticide has been thoroughly evaluated over a period of several years in experimental plots and on commercial acreages. It is one of our most effective aphidicides and is not affected as much as malathion is by rain immediately following applications.

Because it is a *systemic* chemical that

is absorbed by the plant, good results will be obtained with less complete coverage with dimethoate than with malathion, so that better results will be obtained with plane applications. It is also a relatively safe chemical with a minimum of operator hazard.

Dimethoate applied at 2 ounces per acre by ground equipment has given a full 3 weeks of protection against the pea aphid—more than any other insecticide tested. With airplane application it is recommended that 3 ounces actual be used, although under favorable conditions 2 ounces should be sufficient.



Plant protected by insecticide—(left) not infested with aphids, but plant not treated with insecticide (right) has heavy cabbage looper and aphid infection. Edible portion of plant destroyed.

In seasons when aphids occur late in development of the pea plant, that is, after full bloom, malathion at 1 pound actual should be applied. It can be used up to 7 days before harvest and the vines fed to livestock. Where vines are not fed, malathion may be used 3 days before harvest. When malathion is applied by air it should be under favorable conditions; heavy wind or rain during or shortly after application will reduce effectiveness of this chemical.

It is hoped that a definite tolerance will be established for dimethoate in

the not too distant future. When this is done and the time limitation can safely be reduced, this insecticide will be more practical for use on vegetable crops. It is, incidentally, one of our most effective insecticides for control of green peach aphid, which is a pest of several vegetable crops, including potatoes and spinach.

With the appearance of dimethoate as an insecticide that is so effective on peas it is probable that recommendations for pea aphid control will not be changed again soon.

Project H-46-e

Chemical Control of Insect Pests of Sweet Corn

Soil-borne insects that attack corn seed and young corn plants often cause such severe losses to newly planted fields that replanting is necessary. Some of the chlorinated hydrocarbons such as heptachlor and dieldrin have given good control of these pests, but more effective and desirable controls may soon be recommended. Some organic phosphorous compounds and carbamate insecticides have been tried in experiments and show promise of being more

effective than the previously used hydrocarbon insecticides. Phorate and Di-Syston are two examples of such chemicals that may soon be used to greater advantage for soil-borne insects.

Current studies now underway are directed toward more effective controls of the European corn borer and are designed to find better insecticides and to furnish information as to their use, especially for reducing infestation in the ears.

Project H-29-n

Control of Fruit Insects

Experiments on the control of codling moth in 1962-1963 were conducted, using three types of equipment to apply the pesticides. The first type was a Johnson Electronic Orchard and Vineyard duster, the second a John Bean model 200 TR speed sprayer used for applying a 3X concentrate, and the third a RSM mist blower designed to apply an 8X concentrate. Various types of dust formulations were tested in a complete program, starting with a delayed dormant and continuing through

the season. Records taken at harvest-time indicated that the control of codling moth was satisfactory, but dusts failed to control other apple pests, such as orchard mites, and some diseases. The experience with this dust equipment showed that it was not satisfactory when used in a complete treatment to control orchard pests, therefore testing this equipment has been discontinued.

Excellent control of codling moth and satisfactory control of all other apple

pests was obtained with the two spray machines using 3X and 8X concentrates. The 3X concentrate gave a quicker knock-down of orchard mites than the 8X, however, after a period of 10 days the number of mites per leaf were about equal. Work with both of these machines will be continued during the 1963 season. In addition, another machine designed to apply up to 33X concentrate will be included in these tests.

Experiments on the control of orchard mites were set up in an orchard having a heavy population of European red mite. Approximately 16 different miticides were used in these tests; and the sprays were applied as a dilute

application, using a portable machine. Results on the effectiveness of each of these materials were obtained by counting the mites on 20 leaves from each plot 1 day before the sprays were applied and at 3-day intervals after application for a period of 4 weeks. The data showed that some of the newer materials were promising enough to justify further testing. However, the best results were obtained with materials listed in our spray calendar and are now being used by all commercial growers. Testing of new miticides which showed promise in 1962 and additional ones will be included in continuing experiments.

Projects H-48 and H-69

Pesticide Residue Studies Emphasized

With increasing restrictions in the use of pesticides, particularly on the chlorinated hydrocarbons, more residue work is badly needed for development of new chemicals that do not persist in the soil or on plants. A number of organic phosphates and more recently several carbamates have shown great effectiveness against some insects and have demonstrated favorable residue characteristics. It is desirable that some of these be developed for use on agricultural crops. Before any can be approved for crop use, a great amount of information on the extent of and the degradation of these materials, both on and in plants and in the soil, is needed. Residues of two such promising chemicals, phosphamidon and dimethoate have been and are being extensively studied in our laboratory.

Completed studies on phosphamidon have involved the evaluation of this insecticide against a large number of insects in the field and extensive determinations of residues on the crops where these insects occurred. Studies



Technical entomologist observes metabolic changes in the blood of an insect during the moulting process.

were also made to determine the effect of light (length of day) and temperature of the rate and extent of uptake and decomposition of this chemical in tomato and potato plants. Work done in our laboratory has been of considerable value in establishing conditions for safe use of this insecticide and its approval for use. This work is now completed and results published in scientific journals.

More recently efforts have been directed toward obtaining information on residues of dimethoate. In field experiments this appears to be one of the most effective and desirable of the newer systemic organic phosphates. It is one of our best aphicides and has been highly effective against spider mites and leafhoppers and is a chemical that promises great value to Maryland agriculture. Dimethoate has a low mammalian toxicity and is relatively unstable, disappearing on most crops in two or three weeks. Because of its instability it does not accumulate in the soil or in water. Its residues, therefore, do not affect succeeding crops in the field or fish in ponds and rivers.

Studies on dimethoate residues have

been extended to cover a large number of vegetables, emphasis being placed on those crops where present insecticidal control measures are not satisfactory and improved control is needed. This includes the cole and salad crops.

Considerable work has already been completed and approval obtained for its use on apples, peas and potatoes on a zero-tolerance basis. It is hoped that its use will soon be extended on a basis of information now at hand or that will be completed in the near future.

In addition to the work on phosphamidon and dimethoate residues of Dylox, Di-syston, systox, Guthion and Co-ral have been studied in or on some of the minor vegetable crops, and residues of the dimethoate have been studied in tissues of hogs and chickens.

In the near future extensive studies are planned for determination of varying seasonal environmental conditions on residues of Di-syston and phorate in spinach. The relation between the varying extent of such residues resulting from varying dosages and time of application and their effectiveness against the green peach aphid is to be studied also.

Project H-67

Biology and Control of Alfalfa Insects

The most serious insect problem affecting alfalfa continues to be the alfalfa weevil. The development of resistance to heptachlor and dieldrin plus the persistence of the residues of these insecticides on hay has necessitated an intensification of research effort to find new chemicals for control of the weevil.

Special emphasis is currently being given to nonchemical means of suppressing alfalfa weevil populations. The importance of early cutting in reducing weevil numbers has been demonstrated. Also, preliminary studies on the effect of flame cultivation of alfalfa in early spring when the first green appears have shown that significant control can

be achieved with little or no damage to the alfalfa. Further studies of flame cultivation will also show whether this can be done practically on a commercial basis. Flame cultivation not only kills adult weevils, but also destroys old stubble that provides the major oviposition site for the early egg laying by adults.

Studies on weevil attractants are also underway. It is hoped to find the components of alfalfa that are responsible for luring the weevil into alfalfa fields. This information will be of value in breeding resistant alfalfa and in making baits for attracting weevil adults to an insecticide.

Project H-71d

Physiology of Insect Reproduction

Depending on the species of mosquito, copulation is completed in a few seconds to as long as 6 hours. The chase which precedes copulation in most mosquitoes and the ventral orientation of the male reflexly depend upon the head and thoracic ganglia and are entirely separate from the coital reflexes which are exclusively and absolutely controlled by the last abdominal ganglion. Each of the male's coital reflexes can occur independently of the other reflexes. The first two reflexes (movements of claspers and erection of the paraprocts)

are highly non-specific but the last two coital reflexes are extremely specific (erection of the aedeagus and ejaculation occur only after contact with the female's genitalia). In a very rapidly copulating mosquito, like *Aedes aegypti*, the male ejaculates within one to 5 seconds but remains in coitus for 25 to 29 seconds thereafter. He deposits 2000 sperm in the female and from 18% to 92% of these cells successfully swim into the female storage organs within less than 2 minutes and often within 1 minute.

Project II-72

Mosquito Fauna in Selected Swamps, Marshes, and Impoundments

Detailed studies of the hatching of the eggs of several species of mosquitoes have been conducted. Eggs of many important pest mosquitoes including the salt marsh mosquitoes are laid in mud or in dry places which will be flooded at a later time. Eggs of the salt marsh mosquito, *Aedes sollicitans*, normally hatch as soon as the marsh is flooded if the water temperature is high enough. Experimentation with these eggs suggests that relatively small numbers fail to hatch in the fall and that few survive the winter in Maryland marshes. If this

were not true there might be a much more rapid buildup of mosquito populations in the spring.

A careful study of the incubation of the eggs of the southern house mosquito, *Culex pipiens quinquefasciatus* Say, has provided further proof that embryonic development is a direct function of temperature. Information about hatching rates is of value in predicting outbreaks of mosquitoes and in scheduling operations of insecticidal control.

Project II-73-a

Biology and Control of Green Peach Aphid

Basic studies on the biology of the green peach aphid are under way in order to learn something of its ability to build up to large numbers that cause severe losses to tobacco. If such information were available, it possibly could be used to good advantage in insect population control or for prediction of population increases.

Recent work with the use of systemic insecticides indicate that dimethoate

and phosphamidon are effective in controlling green peach aphid. Steps are now being taken by their manufacturers for having these registered for green peach aphid control on tobacco. Tests with granulated systemics sidedressed to tobacco show that phorate, Zinophos, Di-Syston and American Cyanimid 47470 will control green peach aphid.

Project H-74

Comparative Morphology and Physiology of Insect Blood Cells

Studies are being made on the following problems: (1) some of the physiological characteristics of the coagula-

tion of the blood of the cockroach (e.g., the effects of various inhibitors, hormones, and inter- and intra-specific

cross of cells and plasma), (2) the effects of different withdrawal techniques on total and differential hemocyte counts on the origin of a fat-laden blood cell in the wax moth larva, and (3) the effects of hormones and injury on the total and differential hemocyte counts as well as on the blood volume of the blood-sucking bug *Rhodnius*.

Project H-76

Proteins and Amino Acid Metabolism in Insects

This study is continuing at a rapid pace. Current work deals with the effect of ecdysone (the molting hormone in insects) on the protein metabolism in insects. Of 24 blood proteins separable with disc electrophoresis of American cockroach blood; 12 are associated with the molting cycle. Most of these are reflections of metabolic changes during the molting process, but one or two seem to play a major direct role in ecdysone action.

It is currently speculated that the hormone ecdysone (a steroid molecule)

is transported by a protein to its sites of action. This same blood protein is high in tyrosinase activity, an important factor in tanning of cuticle after ecdysis. The tyrosinase protein has also been shown to be important in blood melanin formation and may be an active part of the insects natural defense against pathogenic organisms. Information of this nature is of paramount importance in the development of biological control agents.

Project H-78

Work with the Virginia Truck Experiment Station on the Polyhedrosis Virus of the Cabbage Looper

Mass rearing of cabbage looper larvae has been successful in 1963, and a supply of diseases material has been

accumulated for experimental work in the field in this coming season.

Successive generations of loopers in



Graduate student preparing acrylamide gels electrophoresis of insect blood proteins.

quantity were obtained by use of a small ultraviolet lighted rearing room using collard leaves for food. The collards are reared in a screened house free of cabbage loopers and other cabbage insects. The method is simple and inexpensive and requires a minimum of labor. The desired number of looper eggs, usually 100 to 200, are placed on collard leaves in a round 1-gallon ice cream carton. When the eggs hatch, fresh collard leaves are added as needed by the growing worms. It is not necessary to clean or change boxes. The larvae continue to move upward and on the fresh food supply. The cartons are not removed from the ultraviolet lighted rearing room, and with little handling of larvae during their growing period infection with virus is kept at a minimum.

When larvae are three-quarters grown they are taken to the Virginia Truck Experiment Station where they are placed on virus-infected food. Within 3 days all larvae are diseased and accumulated in glass containers where they are left at room temperature until their bodies have reached a point of disintegration from the virus. The dis-

eased material is then held in frozen storage until standardized for use.

The first field experiment in Maryland on effectiveness of the virus in the field was conducted this past season. Results were encouraging but indicate further work is necessary, particularly on looper control on crops other than cabbage and its relatives. Such is planned this coming year.

Studies have been initiated to determine the means and extent of the winter carryover of the virus in the field. The polyhedrosis virus has occurred naturally for many years on the Eastern Shore of Maryland and Virginia. It is felt more should be known about this source of infection of cabbage looper and its relationship to the artificial infection resulting from experimental treatments. Natural infections do not usually occur until heavy looper populations develop on host crops, so that serious damage is caused before looper populations are reduced by the virus. Under conditions of artificial infection, looper populations never reach high levels which in turn may effect natural winter carryover. More information is needed in this area. *Project H-81*

Chemosterilization of Insects

Several chemicals are known which when administered to insects at appropriate dosage levels will render them incapable of reproducing. These compounds are being investigated by the United States Department of Agriculture and other agencies with the idea that they can be used as substitutes for gamma irradiation in the application of the "sterile-male technique" of insect control. One of these materials, apholate, has been studied in a laboratory of the Department of Entomology.

Larvae of the southern house mosquito were treated at various dosage levels, and the optimum concentration

and exposure time were established. It was learned that treatment of females (later mated to normal males) caused a reduction in egg laying and in egg viability. Treatment of males exclusively resulted in production of mostly non-viable eggs. In most ratios of treated and normal males competing for virgin females, treated males were sexually more competitive than normal males. Some of the effects of treatments on reproductive tissues and cells have been observed and recorded. Much preliminary laboratory work must precede field studies of apholate.

Project H-82

HOME ECONOMICS

The Department of Textiles and Clothing has completed the statistical work on permeability data available. Part II of the report "Consumer Satisfaction With Men's Shirts and with Women's Slips and Casual Street Dresses" is in preparation. Findings on fat excretion on diets containing different levels of fat will also be published. Three Northeastern States are cooperating with the College of Home Economics, Maryland University, in the research program. The findings are to be published cooperatively.

Fat Excretion on Diets Containing Different Levels of Fat

The quantity of fat in the American diet has increased markedly as food surpluses have increased. Fat, visible and invisible in the diet, makes food rich and meals more palatable and satisfying. Fats yield more calories per gram than any other food; and they usually carry with them essential fatty acids and the Vitamins A, D, E and K. When our food habits change to contain 10 to 15 percent more of our daily calories as fat; however, it is possible that body processes can make adjustments. Usually, the body stores excess fat—and a gain in body weight occurs. Under metabolic experimentation, the food intake can be controlled so that a gain in body weight does not occur. By eating less carbohydrate and keeping the calories at weight-maintenance level, the utilization of large quantities of dietary fat may be studied.

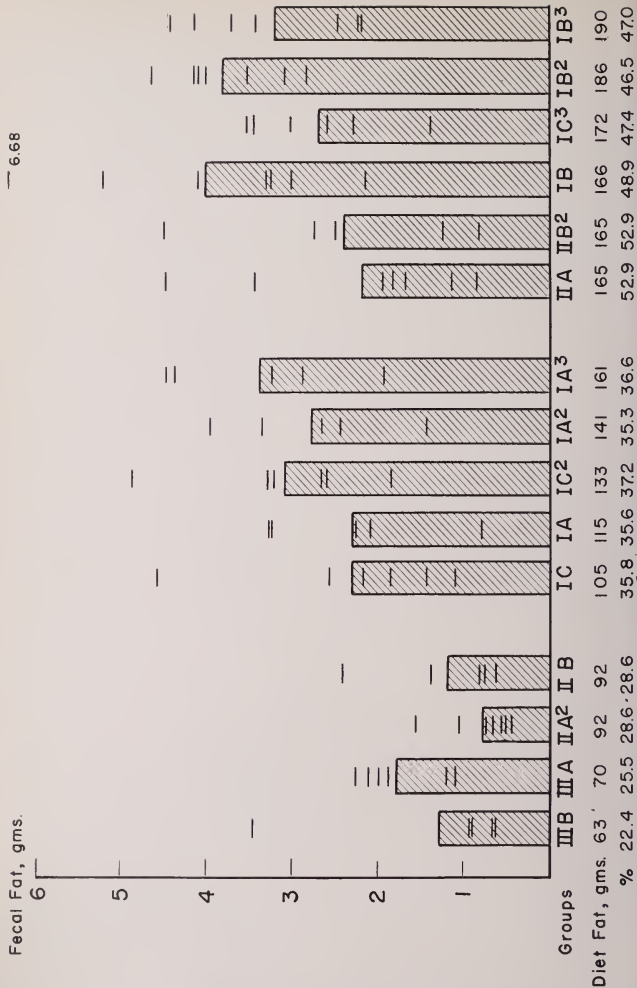
By analyzing food composites of diets, the exact fat intake can be calculated. By analyzing fat content of stools of the subjects, the unused or unstored dietary fat can be determined. The difference between these two figures gives the amount of fat used or left in the body. The fecal fat was formerly thought to be derived from food fat that had not been digested and absorbed, from bacteria and from trauma in the intestinal mucosa. But evidence has been accumulated that it is not unabsorbed material alone but is largely the product of secretion or excretion into the intestine. General agreement now is that, under

normal conditions, fecal lipids are of endogenous origin and can no longer be regarded as unabsorbed fragments of the diet. Some early workers held the view that the percentage fat content of the dry stool was a physiological constant. Recent studies with a small number of subjects indicate that their fat content is quite variable.

Three metabolic experiments conducted by this laboratory employed 41 different college women who at diets that were controlled for fat, protein and caloric intake. The levels of fat were 24, 36 and 48 percent of the total daily calories. The 24-percent level is considered average for the past few decades; and the 48 percent level is as high as that consumed by many Americans now, although the average is believed to be about 42 percent of the daily calories.

Diet composites and excretions were analyzed for ether-soluble fat by the Soxhlet method. It was found that individuals varied widely in their excretion of fat, regardless of body size, body weight, quantity of fat intake, quantity of protein intake, caloric intake or length of time on experiment (see chart). There was a tendency to excrete more fat when more fat was eaten.

There was a significant increase in fat excretion when a level of 48% of the daily calories, as compared to a level of 24%, was eaten. This was equivalent to an increase of approximately 100 grams of dietary fat.



Mean fat excretion of each dietary group (columns). Lines within and above columns indicate mean individual excretions (-). % indicates the percent fat of the total daily energy intake.

HORTICULTURE

Horticulture is an important industry in large sections of the State. Normally, the better the fruit, the more profit it is to the grower and the more satisfaction to the consumer. Research labors constantly to improve and protect current crops and the trees and vines that bear them.

Production of Broccoli for Processing

Profitable production of broccoli for processing requires high yields of good-quality heads. Relatively uniform maturity is desirable to permit harvesting over a short period, preferably in a single cutting. Adequate control of insects and diseases is a necessity. For several years studies have been carried on by the University of Maryland to determine the effects of various factors, including irrigation, plant population, varieties, time and method of planting, and fertilization on broccoli production.

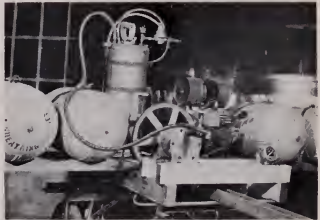
Irrigation is of unquestionable value in getting broccoli plants started in midsummer when the weather is likely to be hot and dry. Under such conditions, seed placed at shallow depths fail to sprout and grow, transplants may not survive unless water is provided. Irrigation following the initial establishment of plants, however, has not been highly beneficial. In only 1 year out of 6 have yields been substantially improved by irrigation after the period of plant establishment. The lack of response to irrigation is probably due largely to cool weather and short days during September and October during the period of maximum growth, resulting in low rates of water loss from the soil.

Broccoli yields increase markedly with increases in plant population from

about 7250 plants per acre (plants 2 feet apart in 3-foot rows) to more than 14,500 plants per acre (plants 1 foot apart in 3-foot rows). Larger populations also result in smaller head size and lower incidence of hollow stem.

Direct seeding of broccoli in the field where it is to mature is a practical means of obtaining high plant populations, provided irrigation is available to maintain adequate soil moisture. An effective herbicide also is essential, as is suitable planting equipment that will properly space seed and reduce the problem of hand thinning.

Most broccoli varieties are by nature nonuniform in many characters, includ-



Exponential sprayer for screening growth regulators. Successive plots are sprayed, and the effectiveness is indicated by the increase of quick-growing plants in each bed.

ing time of maturity of terminal heads. Frequently from 4 to 6 cuttings at about weekly intervals are needed to complete the harvesting of a given field. Varieties vary in maximum percentage of heads ready to harvest at one time from 25 percent to as high as 50 to 60 percent. Waltham 29, the standard processing variety in the East, generally matures about 50 percent of the terminal heads ready for cutting at a single harvest; 70 to 80 percent may be cut in two consecutive harvests about a week apart.

Sweet Corn Breeding

In cooperation with other members contributing to Regional Project NE-32, performance data were obtained this year for 19 experimental hybrids and for 4 commercial hybrids produced by cytoplasmic and by conventional methods. These data will be consolidated for later reporting with those obtained from all cooperators.

Coordinated testing of sweet corn hybrids by participants in the NE-32 program commenced in 1956. In June of 1963, a bulletin was published (Penna. Agri. Expt. Sta. Bul. 704) describing procedures, hybrids tested, results obtained from 1956 through 1960, and an appraisal of the value of the Regional Trial.

In addition to the cooperative Regional Trial, each cooperating Experiment Station conducts some aspect of basic research work. The Maryland Station is specifically involved in the production of cytoplasmic male-sterile inbreds and pollen restoration inbreds which will be used for the production of improved, widely adapted hybrid vari-

The optimum time for direct seeding of Waltham 29 on the Eastern Shore of Maryland is from about July 5-15. Direct seeding at this time results in yield and quality essentially equal to planting in a seed bed in late June and transplanting to the field in early August. Earlier direct seeding produces heads that tend to be leafy and of poor quality, and later seeding gives reduced yields. Optimum seeding dates for other varieties vary somewhat with the time they require to reach maturity.

Project Q-32

eties for Maryland and the Northeast Region. Last year the third inbred generation was obtained from two basic composites. Approximately 100 lines having 18-22 kernel rows in combination with deep kernels are now ready for combining ability studies.

Last year crosses were made between ear worm resistant lines obtained from the United States Vegetable Breeding Laboratory and from other sources in order to concentrate genes governing resistance. It seems probable that resistance can be improved greatly by selection in succeeding generations following the F₁.

Work conducted at the Pennsylvania Station during the past three years indicates that various endosperm gene mutants in particular combinations are considerably sweeter than normal *su*₁ sweet corn and will retain their sweetness for a much longer storage period. In 1963, the Pennsylvania and Maryland Stations began transferring these mutant genes (*ae du wx*) to standard inbred lines.

Project Q-81-c

Potassium Essential for Woody Plants

Increased applications of potassium to the soil increased the growth of *Pyracantha coccinea* and *Ilex crenata* growing in 1-gallon containers. Plants of these 2 kinds, when growing in a soil-peat mixture with a low level of potassium, were small and generally dwarfed and with small, yellowish-green foliage, which dropped prematurely in the fall. These plants had been grown

in soils with a known history of previous phosphorus and potassium fertilization. They showed little response to increases in applied phosphorus. When both the phosphorus and potassium were present, growth was uniform, foliage was dark and remained on the plant into the winter months as is typical for well grown plants of these species.

Project I-79-M

Improvement of Soils for Greenhouse Crops

Greenhouse operators find it necessary to improve native soils to make them suitable for the conditions of intensive culture. The materials used to improve soils include common organic types, such as rotted manures, leaf-mold, and peats, and inorganic materials, such as sand and cinders. Recently, some light-weight aggregates used in the building industry have found use as soil-conditioning agents.

Experiments conducted over a number of years have shown peat moss (peat derived from sphagnum moss) to be the most satisfactory soil-amending material. Peat moss is beneficial when mixed in any proportion with native soils. It alone proved to be a satisfactory soil substitute, provided ground limestone were added to adjust the acidity to the requirements of the crop. Test crops included a number of potted plants and roses, carnations, chrysanthemums and snapdragons.

Peanut hulls have also proved satisfactory as a soil amendment. Addition of a large proportion of peanut hulls

was associated with several crop problems. One of these was the introduction of root disease organisms, but these were controlled by adequate soil steaming. Soluble materials were being leached from the peanut hulls only in the first crop.

Sand, a commonly used material, gave the least benefit of any of the organic amendments. The light-weight aggregates such as perlite, solite, or arcilite, which have some natural porosity, gave much better results than sand but generally were not so effective as peat moss. Other sources and forms of peat were generally satisfactory when used with soil.

Mixtures predominately peat moss with an inorganic diluent, such as perlite or arcilite, were satisfactory as soil substitutes although no better than peat moss used alone. With adequate liming, such soil substitutes are capable of producing satisfactory crops with the same watering and fertility-control practices as those used with soil.

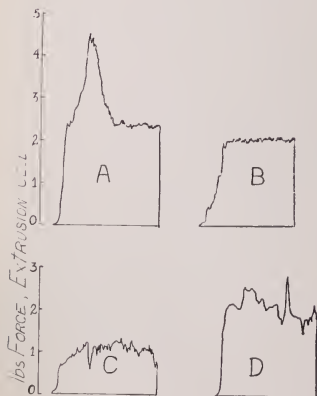
Projects I-74-a and I-74-b.

Testing Texture of Raw Vegetables for Processing

In past years, work under this project was concentrated on the measurement of texture of raw products for processing. For this purpose the shear-press was developed, which was capable of compressing, shearing, or cutting, raw vegetable products such as peas, sweet corn, lima beans, asparagus, etc. The force required to perform these functions was measured by a dynamometer and indicated on a dial, gage, or recorder. The measurement served as an indication of chewiness, toughness, etc., of the product measured.

More recently attention was directed to the softer processed products and to other finished products such as jams and jellies. For these purposes it was found that new cells were required and the instrument sensitivity increased to read very low forces. Maryland scientists pioneered in this project. Two new cells were developed and named the "extrusion cell" and the back-extrusion cell. The shape and size of the curves obtained on a chart recorder synchronized with the instrument provided for the first time a complete description of the textural characteristics of these relatively soft materials. Thus, the rising part of the curve describes the compressibility of the gel (which is forced out at the top). The height of the first peak indicates the strength, that is, the force required to break the gel. The downward slope indicates the internal firmness of the mass of the product; and the smoothness of the down stroke indicates the uniformity of the gel. It was also discovered that these curves are characteristic for individual products, so that the identity of the product tested can frequently be recognized by the curve obtained. *Project Q-58-r*

MEASUREMENT OF TEXTURE OF JELLIES



Typical extrusion curves for different gels. A—jellied cranberry sauce. B—apple jelly. C—grape jelly. D—cellulose gum, type 7LP, 20g/250 ml water.



Recording Shear Press



Extrusion Cell



Back-extrusion cell

Food and Feed Values of Pea Crop

The production of peas, corn, and other crops for canning or freezing may sometimes be a marginal operation, because only the portion utilized for human consumption is considered. It was demonstrated that for every ton of edible peas produced, the same acreage will produce 4 to 5 tons of pods and vines that are highly nutritious as animal feed. Studies were conducted in which peas were harvested at different stages of maturity, and yields, quality, and nutritive values of the different plant parts (seeds, pods, vines) were obtained.

It was found that the total plant,

provided an additional 25 to 50% income, as compared to the utilization as human food of the pea seed only. Another important finding was that when tenderometer values of peas go above 140, that is, peas are so mature that they cannot be processed as a fancy product any longer, it is more profitable to simply mow the entire plants and utilize them, seeds and all, for feed rather than go to the expense of hauling the vines to a viner, vining them and attempting to use the seeds for human consumption.

II Project Q-58-a(NIH Project)

Calcium Salts Firm Apple Tissue

Utilization of soft fruits in the summer and overmature fruit in the fall pose a difficult problem for processors of apple slices. An important aspect of canned-slice quality is firmness, an attribute of quality that has been most difficult to control. Careful screening of the raw stock will not entirely alleviate this problem and the use of Ca (calcium) salts during processing has been suggested as a means to firm the fruit.

Results of a 2-year study of Ca firming of apple slices showed that solutions containing 0.5% Ca concentration under commercial processing conditions were very efficient in firming. Increasing

the Ca concentration above 0.5% in solutions in which the slices were immersed did not greatly increase slice firmness. Calcium lactate was a more efficient firming agent than calcium gluconate. Ca salt treatment of soft raw slices held 3 and 4 months in cold storage brought them to an acceptable firmness range even when heat-processed. When Ca treated slices were baked into pies much of the firmness of the original slice was maintained. By comparison, slices untreated with Ca salts and baked into pies lost a large part of the original slice firmness.

Project Q-58-p

Specific Gravity Measures Weight Loss in Stored Sweet Potatoes

Determination of specific gravity of sweet potatoes from time of harvest through extended periods of storage have shown a decided decrease during storage. Varieties not only differ markedly in specific gravity at time of harvest but also exhibit different rates of change during storage. Storage be-

havior of a variety was related to the amount of change in specific gravity during storage rather than to the value at time of harvest.

Varieties such as Nemagold and Jersey Orange, which are considered to have a relatively short storage life, showed rapid change in sp gr during

storage. The varieties Goldrush and Nemagold had values of 1.004 and 1.002 at time of harvest; but after 7 months storage the sp gr of Goldrush was 0.953 and that of Nemagold only 0.848.

When sweet potatoes were at 60° F and under high relative humidity (85-95%) weight losses were accounted for by the change in sp gr. Under recommended storage conditions, there is es-

entially no volume change in sweet potatoes during storage.

The differential change in sp gr among varieties may affect appreciably the weight-volume relationships. For example, at time of harvest the variety Nugget weighed about ½ lb. more per bushel than Nemagold. However, at the end of 7 months storage Nugget weighed about 6 lbs more per bushel than Nemagold.

Project Q-74

Advanced Breeding Lines of Vegetables

A wide spectrum of new varieties and advanced breeding lines of some of the important vegetable crops used for processing are studied annually. These studies cover all phases of raw-product production, preparation, processing, and finished quality. The latest, most notable snap bean introductions are Gallatin 50, VIP, and Bush Blue Lake. An advanced breeding line, Code 10, is scheduled for release in the near future. It is a true white-seeded, Tendercrop type.

New lima bean varieties are being developed. Several green-seeded Fordhook lines are under study, as well as a

baby Fordhook type with exceptionally fine color and flavor. New strains of the baby lima variety Thaxter, which have more concentrated set, are under observation.

A new F₁ spinach hybrid, named Savoy Hybrid 56, was released to seedsmen cooperatively with the United States Department of Agriculture and the Maryland Agricultural Experiment Station. This variety was developed for fall and winter production only and is highly resistant to Blue Mold and blight. It is acceptable for both processing and fresh market.

Project Q-74



New resistant variety of Spinach.

Pectic Substances Affect Firmness of Processed Sweet Potatoes

It has been shown in earlier work that holding sweet potatoes after harvesting resulted in an undesirable soft-processed product. Investigation of the biochemical changes taking place during the holding period and during processing have indicated that the amount and nature of the pectic compounds in the sweet potato are closely related to the firmness of the processed product. Samples with a desirable degree of firmness were found to contain relatively large amounts of protopectin whereas soft samples contained larger amounts of soluble pectin materials. The wide varietal differences in firm-

ness observed were also found to be related to the pectic substances present.

For example, the Nemagold variety which is subject to softening, showed a rapid change in the pectic materials while the Nugget variety, which maintains firmness even after prolonged post-harvest holding, showed relatively little change in the pectic substances. This evidence that the pectic substances are involved in the texture of processed sweet potatoes gives a biochemical basis for the effect of calcium salts on firmness.

Project Q-79-g

Apple Storage Life Reduced by Excess Boron

Annual early-season sprays of boron, up to three in number, are being applied in Maryland to reduce the development of cork spot in the York apple. Research, which led to this practice, is being continued to study the effects of excess boron.

Six early-season sprays of boron greatly stimulated water-core formation in fruits, and led to development of internal browning and breakdown in storage, especially in the water-cored areas. In this manner, six sprays sharply reduced the storage life of the fruit, but three sprays of boron produced variable results in this regard.

Fruit analyses indicated that boron-sprayed fruits lost starch very early during maturation and increased in sugar

concentration more rapidly than did unsprayed fruits. Sprayed fruits also colored earlier, but did not develop more color ultimately, as has happened in some previous experiments. While these results suggest that boron-sprayed apples matured earlier, these same fruits softened much more slowly during maturation and storage, an effect which could have resulted from the marked stimulation by boron of the enzyme pectin-methylesterase, which is associated with pectic changes.

The results indicate that no danger exists that boron might accumulate to dangerously high levels from present spray practices in commercial orchards of the state.

Project L-79-e

Supersports of Red Delicious Evaluated

During the past 15 years, red sports of Delicious apples have been producing deeper red mutations in commercial orchards than has ever been known for this, the nation's leading apple variety. The more promising of these new sports have been fruited several years at College Park for evaluation.

Consistently outstanding in these trials has been Topred and Red Queen.

The former has a solid red color; the latter develops a striped pattern on the fruit. Included among those that have been good are Royal Red, Ryan Red, Hauser Red, Chelan Red, and Hi-Early.

In this group Chelan Red has superior color development, but is characteristically small-fruited; thus this sport is not desirable for commercial



These Golden Delicious apple slices have been firmed with 5 percent calcium lactate. This treatment improves the appearance and firmness, which is maintained during and after baking.

planting. Somewhat variable from year to year are Red Prince, Red King, and Earlired. These strains have exhibited excellent color and finish in some seasons, but not in others. Unacceptable among the new sports studied at College Park is Hired.

Among the Delicious sports of recent years that have aroused much grower interest have been the so-called spur types. This type of sport mutated not only for high red fruit color, but also for a dense, compact type of tree growth habit with greater spur development than has been known for the variety.

The three leading initial spur types,

Redspur, Wellspur, and Starkrimson, have been fruited at College Park for several years, and all have been found inferior in fruit color to the nonspur types listed above. Whereas the spur types fruit earlier in the life of the tree, it is now clear that fruit maturity is somewhat delayed, as compared to the nonspur sports. By delaying the harvest of spur types, fruit color has been improved to nearly that of the nonspur. Storage life of all of the various sports studied has been comparable to that of Richared, the standard red sport of Delicious fruited in Maryland for more than 30 years.

Project L-73

POULTRY

Research in the field of poultry science as carried out at the Poultry Department of the University of Maryland is a combination of applied research which may have immediate application, and also of more basic research which may or may not yield findings that are applicable. In general, though, all research is aimed toward solving practical problems, not just collecting knowledge for the sake of knowledge. It is impossible to predict when "basic" findings will become immediately useful.

As the problems become more complicated, research dealing with them must become more basic and more sophisticated or involved. Delicate interrelationships which complicate the application of knowledge come to light. By and large, the poultry industry has shown remarkable foresight and ingenuity in ever-increasing the efficiency of production of highly nutritious and delicious animal products. Progress in this area will unquestionably continue in the future; and this progress is contingent upon well-conceived and well-executed research projects. The research laboratories and field stations of the Poultry Department are always open for inspection; and we are glad to discuss our current research program with those interested.

Tests of Systemic Insecticides for Poultry

Is it possible to give poultry an insecticide in the feed and thus gain control of maggots or flies in the manure, or to control any of the parasites, such as lice or intestinal worms? How safe from the human standpoint would such a practice be? These and other questions, including the effects upon the chicken itself, were studied intensively, using four different drugs and combinations among them for this purpose. In all cases, the drugs were fed continuously at various *low-to-medium levels* in the feed.

The most promising results to date have been in the field of reduction of population of either maggots or adult flies in the manure. In one drug, reduction of adult flies up to 95 percent was achieved, but there was no apparent control of maggots in the manure. In a test of another drug, excellent control of both maggots and emerged flies was obtained.

There have been as yet no worthwhile results in the control of external

parasites such as body lice. Chickens have tolerated the levels of drugs quite well, and no mortality has resulted; although at higher levels of dosage, evidence of toxicity for some drugs was found upon autopsy. Residue studies on eggs and the poultry carcasses also have been encouraging, but so far this work on some drugs is incomplete.

It appears that control of maggots and adult flies in manure by systemic insecticides is a real possibility; but much research is necessary before such drugs can be available for field use in the United States. Control of the chicken body louse and other blood-consuming external parasites would seem to be dependent upon new chemicals, or the extensive screening of existing chemicals, before such can be considered practical. Results are definitely encouraging. One chemical has been shown by an investigator to do exactly that: kill mites fed on the blood of insecticide-fed birds.

Project M-60

Causes of Bruising in Transportation of Live Broilers

Ten to fifteen percent of the broilers are bruised, causing serious downgrading as well as loss in yield. It is estimated that this cause alone is costing \$800 to \$1500 per week in some processing plants.

In cooperation with processors and people involved in transporting birds, slow-motion pictures have been taken and carefully studied to determine exactly how birds are bruised. This action has been taken during loading and unloading at three different plants. The pictures clearly indicate that the birds are hitting the edge of the coop opening in loading. They also show that birds are bruised during the unloading operation by coming down a conveyor suddenly stopped, causing them to pile up on one side of the coop, resulting in considerable bruising of breasts. The

birds do not get such an impact in being unloaded onto a waist-high conveyor.

An 8-month test indicates no significant change in bruising during the colder months. Neither does the data clearly indicate a considerable difference in bruising between different weight birds; although, the tendency is for larger birds to get more bruising. Broken bones are negatively correlated with bruising; that is, the more broken bones there are, the less bruising may be reported, probably because the broken bone is no longer considered a bruise. In this study nine factors and their effect or relationship to bruising have been studied. The analysis is not yet completed.

Project M-61

Trace Minerals in Poultry Nutrition

A level of 1.2 percent calcium in starting poult rations was found adequate to support normal growth and bone development. An available phosphorus level of 0.7 percent provides a desirable margin of safety to guard against the hazard of "low phosphorus rickets."

The magnesium requirement for starting chicks was found to be 265 ppm, and for starting poults 410 ppm. A 6-months' study with laying hens indicated this requirement to be no higher than 1200 ppm. Hens were fed for 4 months on rations containing 9000 ppm (0.9%) magnesium, with no ill effects other than slightly moist droppings. These results indicate that practical type corn-soy rations will seldom, if ever, be sufficiently low in magnesium

to require specific supplementation, and that moderate excesses of magnesium can be tolerated for considerable periods with no serious effects.

An investigation of zinc deficiency, using highly purified diets, has shown this mineral to be required by chicks and poults for growth, feathering, bone, skin and general development. Zinc has been found to be critically important to the developing chick embryo, a deficiency in the egg causing a high death rate and a variety of skeletal anomalies. Chicks which hatch chomzine-deficient eggs are weak and may not develop normally even if fed starting rations fully adequate in zinc.

Serious zinc deficiencies in commercial poultry rations are unlikely, but supplementation of chicken rations with

25 ppm, and turkey rations with 50 ppm of zinc is an inexpensive precautionary measure.

Studies with turkey poultz have indicated that the requirement for potassium in practical starting rations con-

taining an antibiotic is probably no greater than 0.4 percent. Commercial rations normally contain considerably more than this and deficiencies under practical conditions are unlikely.

Project M-203



2. A miniature poultry-dressing plant is used to study the influence of various methods of slaughter and feather removal.

Quality Retention in Poultry Meats in Processing

Feather removal in the poultry-processing plant is probably the one most costly operations performed. This involves heating 3,000 to 4,000 gallons of water and maintaining a temperature of about 125° F with a continuous addition of water. About 15 people may be employed in removing pin feathers and in hand "pinning" the birds in addition to tending four to six machines that remove feathers. Beating during the feather-removal process causes toughness or "bark", and may increase the bacterial population. Still, after all of these processes there are a few feathers left.

Research has centered on trying to find if there is an area in the nervous system that had controls feather release. Previous work has been conducted on this, but all of the studies have been on old chickens. All of our research here has been on broiler-type chickens.

Considerable effort was devoted to developing and using different staining techniques to differentiate areas for histological studies. Passing a direct current through the electrode deposits a little iron in the lesion. This small deposit of iron can then be easily stained to determine the area of the lesion.

Another study under this project is to determine the accuracy of blood-volume studies, the amount of blood lost in bleeding and the amount remaining in various cuts of meat. This study is in cooperation with the USDA. Thus far the work has centered on the disappearance of radioactive tracers

and the amount of plasma trapped in the cells during centrifuging. Later this work will be directed to blood loss by different methods of slaughter and the amount of blood removed with the viscera.

Project M-100

Effect of Freezing and Reversible Inhibitors on Chicken Sperm

Effort is continuing toward the goal of finding a satisfactory technique for freezing fowl semen. Although bovine semen is satisfactorily stored in the frozen state for considerable periods, the techniques used for bull semen are completely inadequate for fowl semen. Preservation of semen by freezing would be the most useful tool for the chicken breeder, and might well enhance the program of artificial insemination in common use with turkeys. Several compounds have been tested for their ability to protect during freezing. These have included glycerol, ethylene glycol, propylene glycol, and various sugars. None of the other agents has proved as satisfactory as glycerol.

It is found that glycerol can be added directly to the semen and the mixture frozen immediately. The technique is as satisfactory in preserving motility following freezing as when the mixture is allowed to equilibrate before freezing. This seems that it is necessary to protect

against crystalline formation in the intercellular water rather than in the intracellular water. Methods have been developed whereby as much as 8 percent glycerol can be added to the semen mixture and then subsequently removed without seriously impairing the fertilizing capacity. The reduction in glycerol is important, although it has generally been found that semen samples containing more than 2 or 3 percent glycerol have practically no fertilizing capacity.

Temperatures of 15° and 27° C. have been investigated as possible levels for carrying out the dilution equilibration and glycerol removal techniques. The preferable temperature is 15° C. Percentage cell volume, which would be an indication of cell size, has not generally been affected by holding temperature nor by the various diluents used. In this respect, the motility of semen samples is not adversely affected by rather hypotonic solutions.

Project M-302

Effect of Protein Adequacy on the Efficiency of Selection of Turkeys for Early Fattening

Because of apparently uncontrollable poor fertility and hatchability, no progress was made toward the objectives

of this project in the past year.

Project M-400

Alkaline Phosphatase and Egg Production

This project is an attempt to find out if egg production can be improved by breeding for a high level of a chemical in blood serum—specifically, the enzyme alkaline phosphatase. A line has been developed by selective breeding with a phosphatase level three times that of a control line. This difference exists from 2 weeks to at least 2½

years of age. In four out of five years, egg production of the high phosphatase line has been significantly higher than that of the unselected control line. Birds of the high line have weighed a quarter of a pound less than those of the control line, but have not differed in minority rate or quality of their eggs.

Project M-32-m

Cholesterol Level Selection Experiments

Can egg production, body weight, and other productive traits be improved by selection for high or low cholesterol level in blood serum? The research project was designed specifically to answer this question. The answer, in short, is *no*!

This was demonstrated by the establishment of two lines through selective breeding, one with high and the other with low cholesterol level at 6 weeks of

age. After 5 generations of selection, the cholesterol level was 30 percent greater in the high line than in the low line. However, there was little difference between the lines in the productive traits measured, such as egg number, egg quality, mortality, and growth rate. In the few instances where there was a difference, it was because of lowered performance of one of the lines.

Project M-33-c, NE-6



1. Researchers use artificial insemination for hens in cages, as part of a breeding project studying the importance of different blood enzymes.

Serum Enzymes and Genetic Resistance to Leucosis

Research has started to find out the biochemical basis for genetic resistance to leucosis, a cancer-like disease of chickens. Levels of ten serum enzymes have been measured in two strains of chickens obtained elsewhere, one of which is resistant and one of which is

susceptible to leucosis. The level of one of these enzymes, cathepsin, was markedly higher in the resistant than in the susceptible strain. Further research will be conducted on the relationship of this enzyme to leucosis.

Project M-303, NE-51

Toxic Molds

Stachybotrys atra is a mold which grows preferentially on cellulose or woody products such as are used for poultry litter and produces a powerful irritant or toxin. When applied to the skin of a chicken or laboratory animal it produces marked lesions. When in-

gested by chicks it destroys the lining of the mouth or crop and permits parasitic organisms to enter and grow. The toxin is soluble in both water and fat. It does not appear to be any of the simple organic acids normally produced by fungi.

Project M-205

Variation of Louse Numbers on Poultry

Much variation in the susceptibility of people to the biting of that pesky nocturnal insect, the mosquito has been observed. It has now been found that chickens are equally variable in their attractiveness to the chicken body louse, and that these differences are inherited. Significant differences were found among families following uniform inoculation with live lice, and the opportunity for uniform build-up of louse numbers in the flock kept under floor conditions. An interesting observation is that the ability to resist the build-up of louse numbers was inherited from

the dams, and not from the sires.

The control of the chicken body louse has been shown conclusively to be important to the pocketbook of the farmer. The louse cannot be considered a comparatively harmless insect. Such control will continue to be by use of low-cost suitable insecticides. The inherited family differences, however, will point the way to improved understanding and eventual control of insects, as it adds to the knowledge of the important insect-host relationship.

Project M-57

Studies on Microorganisms Important to the Poultry Industry

The nutrition of *Mycoplasma* (PPLO), important disease-producing microorganisms in poultry and humans, is being studied. A medium has been developed for the nonpathogenic J strain, which is synthetic except for a very small amount of a tryptic digest of casein. Knowledge gained about nutrition of the microorganisms might give clues leading to new drugs for treatment of the disease. If these mi-

nute organisms can be grown in quantity, they might be used as antigens for producing resistance in poultry.

Studies on lipid metabolism in the protozoan *Tetrahymena* have shown that triparanol (Mer 29), which interferes with sterol formation in animals, also interferes with the normal synthesis of fatty acids, and the conversion of branched and saturated fatty acids to unsaturated fatty acids. *Project M-58*

Amino Acid Requirement Studies

The dietary requirement for lysine and total sulfur amino acids (methionine+cystine) of broiler chickens has been determined for both the starting and growing periods. These requirements have been expressed as a function of the metabolizable energy intake.

They, together with adapted values for the other essential amino acids based on data of other investigation, have given excellent results when used as specifications for computing broiler rations by linear programming.

Project M-200

Protein Level and Balance of Voluntary Food Intake

Studies have been conducted to determine the effect of dietary protein level and the balance of essential amino acids making up the protein on the voluntary food consumption of chicks. It has been shown that the *ad libitum* food intake progressively increases in relation to energy needs as the protein level is reduced, without change in amino acid quality. This is reflected by marked increases in percent body fat and decreases in percent body protein and water.

In contrast, chicks fed diets containing the same protein level, but varying in amino acid balance (protein quality), showed no increase in body-fat content even though similar differences in body-weight gain were obtained. Moreover, further addition to amino acids, not first limiting to such diets already containing unbalanced proteins, resulted in further reduction of voluntary food consumption.

These findings clearly show that the level of protein in the diet can influence the voluntary consumption of energy foods and the resulting body composition of the chick. Although the amino acid adequacy or balance also was found to markedly affect food consumption, the body-fat content of chicks fed imbalanced diets was not increased, suggesting that the excess amino acids in the diet may exert a depressing effect

on the chick's appetite and actual consumption of calories in relation to body needs. It is believed that sufficiently high blood levels of metabolites from certain of these excess amino acids occur, and that these in some way influence the "physiological appetite" center to depress voluntary food consumption.

In order to test this hypothesis under practical feeding conditions, floor pen broiler trials have been conducted in which the protein level was progressively raised without increasing the levels of the first critically limiting amino acids, lysine and methionine+cystine. These studies have resulted in the reduction of the metabolizable energy intake per unit gain of from 5 to 9 percent without apparent change in body weight gains. Furthermore, several widely different protein sources, including hydrolyzed feather meal, soybean meal, corn and gluten meal, have been equally effective in increasing the calorie efficiency of the ration, when used to supply the additional protein.

These studies suggest that a better understanding of the effect of protein level, as well as amino acid balance, on the centers which control voluntary food consumption may lead to a material improvement in the efficiency of production of broiler meat and a means of controlling its fat content.

Projects M-202 and M-200

Chick Assay for Available Methionine

Since methionine is likely to be the first limiting amino acid in poultry feeds based largely on soybean meal and corn, a chick assay has been developed for testing the amount of methionine in various feedstuffs available to the growing chick. Materials assayed thus far include different commercial samples of fish meal, soybean meal, corn gluten

meal and corn meal. The amount of food consumed, dietary protein level and balance, as well as changes in body composition and resulting differences in utilization of the first limiting amino acid, have been found to be factors which must be appropriately considered when developing a reliable assay for this purpose. *Project M-202*

Efficient Protein Mixtures for Laying Hens

Continuation of protein level and amino acid requirement studies of laying hens has resulted in maintenance of egg production of 85 percent during a 10-week experimental period with a protein level of only 13 percent. This confirms earlier work at this station

conducted for longer periods, and reflects the reliability of the amino acid estimates based on Maryland methionine requirement data, using the essential amino acid proportions found in whole-egg protein. *Project M-202*

Fat Level, Energy Intake and Egg Size

The effect of various fats on egg weight was studied in a series of experiments with pullets maintained in cages. The fats, which included corn oil, soybean oil, safflower oil, tallow and egg fat, were incorporated into practical corn-soy type rations at levels of 4.5 to 10 percent. Test fats were fed to groups of 60 to 120 pullets; experimental periods averaged 50 days in duration.

Significant egg-weight responses, averaging 1.6 grams per egg, were obtained with all fats except in one trial involving a mixture of animal fat and soybean oil. Egg fat, supplied from dried egg yolk, was highly effective in one trial and without effect in another. Generally, the greatest increases in egg weight were observed with highly un-

saturated oils. These responses also were concomitant with marked increases in caloric intake. When caloric intake was not allowed to exceed that of the controls, no increases in egg weight were obtained from the same fat-supplemented diets in three tests.

In a floor-pen trial involving approximately 800 birds, pullets fed a pelleted feed laid significantly heavier eggs and consumed 7 percent more metabolizable calories than comparable groups receiving the same diet in mash form. These diets contained 1.4 percent linoleic acid by assay.

Metabolizable energy appeared to influence egg weight more than did the linoleic acid intake in these experiments. *Project M-201*

VETERINARY SCIENCE

Research projects in the Department of Veterinary Science are designed to investigate animal ailments troublesome on many Maryland farms. Disease seriously impairs livestock and poultry production, and in some instances animal ailments constitute a hazard to human health. Animals provide 55 to 60 percent of the total farm income in the United States. The financial burden imposed by disease, including death, reduced performance from sickness, and downgrading of animal products on the market has been estimated at 2.7 billions of dollars annually, or about 15 percent of the total income from livestock.

Although much knowledge has been gained in recent times, more information concerning the cause, nature, and control of certain ailments is needed. Studies of animal populations are essential to determine the extent and economic importance of hitherto little-known maladies. In addition, research should be continued on zoonoses—diseases dangerous to human as well as animal health.

Studies on Respiratory Disease of Chickens

An improved indirect hemagglutination test for the diagnosis of infectious bronchitis in chickens has been developed. Treating sheep erythrocytes with formalin solution before treatment with tannic acid solution and sensitization with infectious bronchitis virus yields results superior to those obtained with red cells treated only with tannic acid before sensitization with virus.

Erythrocytes prepared in the manner described above are added in equal volume to 2-fold dilutions of serum. Tests are allowed to stand 4 to 6 hours at room temperature or 18 to 20 hours in a refrigerator at 6°C before being read. A positive test is indicated by a blanket of nonagglutinated red cells in the bottom of the tube. In a negative test, unagglutinated red cells settle to the bottom of the test tube in a small round button. When the improved indirect hemagglutination test was compared with the standard serum neutralization test in chicken embryos, a correlation coefficient of .716 was obtained,

as compared with a coefficient of .318 when the standard test was compared with the previously used method. Formalin-treated sheep erythrocytes showed no tendency to agglutinate spontaneously after storage at 4°C for 9 months and were markedly resistant to lysis.

In the tissue cell cultures, the Beaudette strain of infectious bronchitis virus produced a syncytial type of cytopathogenic effect in chicken-embryo cell cultures. Viral antigen could not be detected by direct fluorescent antibody staining at 1 and 3 hours postinoculation. Specific nuclear staining was observed 7 hours postinoculation.

Twenty-four hours after inoculation, the entire nucleus exhibited a bright granular fluorescence with some release of viral antigen. At 36 hours, the release of antigen was detected in the cytoplasm and the virus entered a second cycle of multiplication. Flazo orange could be successfully used to mask nonspecific fluorescence in tissue culture preparations.

Hemagglutination-inhibition tests on serum from day-old chicks of dams vaccinated against Newcastle disease by tissue culture vaccines were negative. Challenge of similar chicks with virulent Newcastle disease virus revealed parental immunity in 27%. Histopathological examination of the trachea appears to be a more accurate method for evaluation of cross immunity tests for infectious bronchitis (IB) than observation of clinical signs. Research on the Gunboro-Nephrosis syndrome has established that an infectious condition exists. Its relationship with IB is not clear.

Rapid-plate antigen (Conn.) has been used to test field flocks for the presence of *Mycoplasma gallisepticum*. Serum has been used in preference to whole blood. Interpretation of the whole-blood test was difficult in young birds. A multiplier flock of 4500 birds

hatched from PPLO-free stock was periodically tested last year. A 100% test of the pullorum samples showed numerous slow reactors. Subsequent tests were negative and the flock was presumed free of PPLO. Offspring from this flock performed in a satisfactory manner and no unexplained evidence of infection was detected.

Started pullets hatched from PPLO-free stock have been moved on to the same farm this year. These birds are now showing serological evidence of infection. One large operation expects to maintain 160,000 breeders on one farm in the center of the Delmarva Peninsula. It was hoped that PPLO-free stock could be maintained. Random samples were negative up to 17 weeks. Subsequent tests have revealed PPLO in birds from several houses.

Project D-52(NE-5)

Studies on Equine Encephalitis

No cases of eastern equine encephalomyelitis (EEE) were confirmed in the laboratory during 1962, even though specimens from 13 suspected equine cases in Maryland were examined. Studies of avian experimental infections were initiated in order to determine serologic response at various age levels to EEE virus and/or vaccine. Strains of EEE virus from positive equine brains, previously collected, have been retitered and lyophilized for use as reference viruses. Extension of investigations to arboviruses other than FEE virus have included Guaroa, Cache Valley and Chincoteague (M273/61) viruses.

Characterization of Guaroa virus with special emphasis on immune response elicited in animals, its cytopathogenic effect on tissue, complement-fixing and hemagglutinating activity and advantageous methods of propaga-

tion and preparation of seed virus have been conducted. Cache Valley virus, studied from the standpoint of geographic distribution, has been found more prevalently in tidewater areas than in Piedmont or Appalachian locales. Rate of infection appears lowest in wild rodents and highest in horses and cattle. Exact epidemiologic significance of this virus, is, as yet, not known. Preliminary investigations of viruses obtained from mosquito collections in the Assateague-Chincoteague area suggest their being Cache Valley-like in character. Chincoteague (M273/61) virus is being studied to define its epidemiologic role, as well as its specific identity and character. By serial infection with EEE, VEE and WEE viruses, burros have been used successfully in production of a broad spectrum typing serum for Group A arboviruses.

Project D-57

Bovine Mastitis

A method of diagnosing intramammary infection was developed, using one-half ounce French square bottles containing two differential media. Milk was inoculated into the bottles directly at the side of the cow. After incubation at 37°C for 24 hours, hemolytic staphylococci, *Streptococcus agalactiae*, *Pseudomonas* spp., coliforms and *Corynebacterium pyogenes* were differentially identified. In a comparison test, the bottle method detected approximately the same number of quarters infected with *Streptococcus agalactiae* as by the Camp method.

Observations were made as to the relationship of dairy herd environment to streptococcal and staphylococcal infection of bovine udder. An increase in

streptococcal infected quarters was found in herds where there were poor ventilation and crowding in the dairy barn, where the milking operation per cow was longer than average, leading to chronic irritation, and where cows were exposed to minor injuries caused by rocks, glass and wire in the fields.

An increase in staphylococcal infection was found where calves were observed "nursing" one another, where improper and unsterile intramammary treatment was used, and where sanitation prior to milking was poor. Factors which tend to increase herd stress tend to decrease staphylococcal infection and increase streptococcal infection.

Project D-58

Investigation of "Air-Sac" Infection in Poultry

Fourteen strains of *Mycoplasma gallisepticum* (PPLO), including both pathogenic and nonpathogenic strains, obtained from Maryland, other states, and from England were classified on the basis of serological reactions, cultural characteristics and pathogenicity. *M. gallisepticum*, sometimes augmented by secondary infection, is the cause of the so-called "air-sac" infection in poultry. Serological studies consisted of cross-agglutination and agglutinin-absorption tests. Cultural characteristics included determination of colony type on enriched agar and biochemical activity in carbohydrate media.

Pathogenic strains were found to be closely related or serologically identical to each other, with the exception of one strain which contained an antigen not detected in other pathogens and which also exhibited somewhat different biochemical activity in carbohydrate media. The nonpathogenic strains studied, for the most part, were serologically unrelated and exhibited sev-

eral different patterns of carbohydrate activity. A serological survey of Maryland chicken and turkey flocks was made on 20 to 40 serum samples from 22 flocks situated in widely separated parts of the State. Each serum was tested by the tube agglutination method with four antigens representing distinct serotypes, two pathogens and two nonpathogens.

Only one chicken flock reacted to one of the pathogenic serotype isolated in Maryland, and none reacted to the nonpathogenic serotypes. The fluorescent staining technique was employed as a rapid diagnostic method for detection of *Mycoplasma gallisepticum* infection. Using the direct method, fluorescein isothiocyanate was used to label pooled antisera produced in rabbits from several pathogenic PPLO strains. For the indirect staining method, labeled anti-rabbit serum produced in goats was employed. Twenty-five field cases of "air-sac" infection were studied with the fluorescent staining technique.

Nineteen were positive, as indicated by specific fluorescence. Bright, fluorescing, yellowish-green coccoid cells, approximately 0.1 by 0.3 μ in diameter, were

observed in tissue smears, turkey sinai exudate, and filtrates from homogenized lesion tissue.

Project D-59

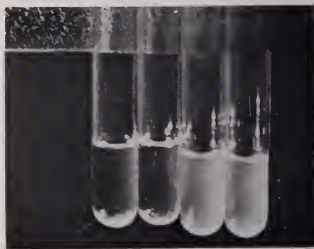
Investigation of Brucellosis in Cattle

A study has begun on the persistent brucella infection in certain problem herds. A series of tests designed to more accurately define the infected animal is being used. In addition, a continuous effort is made to isolate the cause of the infection, utilizing the best research and eradication techniques available, and then applying the knowledge gained in an original manner to handle these problems.

The results obtained in the 6 herds studied to date demonstrate the value of the techniques used. Almost 65% of the reacting animals found by use of this combination of tests would have been left behind by the single Standard Tube Test. Accordingly, these tests were highly efficient at selecting from among the large number reacting at the lower Standard Tube Test ranges animals that were potentially dangerous. In addition, evidence of infection was found in the young, vaccinated heifers in 3 out of the 6 herds. This is more significant when it is realized that 2 out of the 6 did not raise replacements.

A number of sera were collected from vaccinated calves, and the sera of those reacting to the Standard Tube Test were subjected to a series of tests using differing concentrations of salts, antigens, and temperature incubations. No significant differences in titers were observed.

Project D-60



Tube agglutination test to detect brucellosis in cattle. Left—clear tubes, with antigen deposited on the bottom; right—negative tests with antigen in suspension.

Acids in Livers of Sheep with Pregnancy Disease

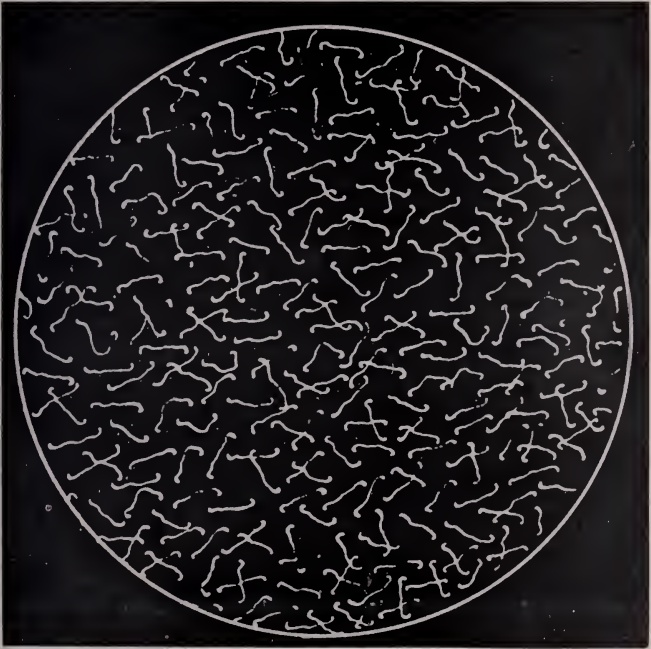
Chromatographic separation of the organic acids present in the livers of sheep with pregnancy disease has revealed acids whose presence was not anticipated. Since unexpected results of this sort are usually worthy of further investigation, an attempt has been

made to identify these unknown compounds. The identification of very small amounts of organic material is difficult and time consuming. Progress has been made, but as yet is not sufficient to warrant a definite statement of results.

Infectious Causes of Infertility in Cattle

Leptospirosis. The testing of normal cattle for leptospiral antibodies has been continued and 19% of the serums tested have been positive with one or more of the battery of 11 leptospiral serotypes employed as antigens. Reports from other states indicate that the principle serologic reactions detected in cattle are for *L. pomona*. However, serologic surveys in Maryland and elsewhere have shown that reactions to leptospiral serotypes other than *L. pomona* may predominate. An evaluation

of the pathogenicity of *L. canicola* for cattle has been carried out, using young calves and the effect of prior infection of calves with *L. canicola* on subsequent exposure to a heterologous or a homologous leptospiral serotype has been investigated. Evidence obtained indicates that *L. canicola*-infected calves are resistant to infection with homologous or related (*L. ballum*) serotypes. One *L. canicola*-infected calf was susceptible to subsequent infection with the heterologous serotype, *L. wolf-*



Leptospira pomona, a bacterial organism causing disease in cattle and swine (greatly magnified).

fi, while another calf was apparently resistant to subsequent infection with the heterotype, *L. pomona*. Further studies on these observations are in progress. Certain *Leptospira* are known to produce a toxin capable of lysing certain erythrocytes. In a study of the action of this so-called hemotoxin, using young sheep, it was noted that cross-protection to the hemotoxins produced by *L. canicola* and *L. pomona* could occur.

Vibriosis. The isolation of *Vibrio fetus*, the causative agent of infertility, is complicated by the overgrowth of saprophytic bacteria, which grow much faster than *Vibrio*.

To overcome the problem of restricting the growth of contaminating microorganisms, while still permitting the isolation of *V. fetus*, the incorporation of several antibiotics into the isolation media has been investigated. Studies have been made to determine the maximum levels of polymyxin, novobiocin, and bacitracin that would permit growth of laboratory cultures of *V. fetus*. Similar studies were made to determine appropriate levels of these antibiotics needed to suppress *Proteus* and *Pseudomonas* microorganisms which generally mask the presence of *Vibrio* by their heavy overgrowth.

This information has been used as a

guide to establish limits within which the concentration of these 3 antibiotics could be varied when culturing preputial samples. Using infected bovine preputial samples, 5 concentrations of polymyxin and novobiocin and 6 of bacitracin were studied to determine their effects on *V. fetus* and other microorganisms. The optimum concentration of each antibiotic was determined by direct counting of the number of *Vibrio* colonies as well as the number of other colonies which appeared. A combination of bacitracin (15 units/ml), polymyxin (1 unit/ml), and novobiocin (5 μ g/ml) was the most effective for isolation of *V. fetus* from bovine preputial sample.

Preputial samples have been cultured, using both the antibiotic medium and Millipore filtration to evaluate the relative efficiency of the two methods. With 56 samples from infected bulls, it was possible to isolate *V. fetus* from 43 samples using the antibiotic medium and from 41 using Millipore filters. When both methods were used, 49 (88%) of the same 56 samples were positive.

The possibility of using fluorescent antibody methods to permit more rapid detection of *V. fetus* is planned.

Project D-62,(NE-40)

Bovine Respiratory Diseases

During the period under report, the combined effect of *Pasteurella multocida* and SF-4 virus upon calves was studied to establish the etiology and ecology of "shipping fever." Calves inoculated with the bacterium 48 hours after exposure to the virus-developed clinical syndromes of "shipping fever." Calves exposed to the same agents in the reverse order responded in a similar way. Calves given both agents simultaneously developed only a mild response. Animals exposed to either agents alone remained normal. Experimental immunization of calves with an SF-4 virus vaccine was not successful, since the controls converted to positive during the holding period. None of the calves experimentally infected with respiratory syncytial virus produced any clinical symptoms, nor did they develop any antibody against the virus.

Preliminary studies of the characteristics of hemadsorbing enteric virus were conducted. The virus was found to be stable, and maximum multiplication of virus was obtained within 96 hours after inoculation. In addition, natural outbreaks of bovine respiratory diseases in Maryland were investigated. From these cases, a number of clinical materials, including lung tissues, rectal, nasal, and ocular swabs were examined in cell cultures for isolation of respiratory viruses. Serum samples from infected animals were collected to de-

termine presence of antibodies against infectious bovine rhinotracheitis and "shipping fever." These studies indicated that infectious bovine rhinotracheitis and "shipping fever" had been prevalent in Maryland cattle.

Project D-63



Bacteriologist in Department of Veterinary Science, using electron micro-scope in study of disease interfering with reproduction of cattle.

STATION STAFF

1962-1963

Agricultural Economics

J. M. Curtis, Ph.D., Prof. and Head
G. M. Beal, Ph.D., Prof.
P. W. Foster, Ph.D., Assoc. Prof.
A. B. Hamilton, M.S., Assoc. Prof.
Sidney Ishee, Ph.D., Assoc. Prof.
J. P. Marshall, Ph.D., Asst. Prof.
J. E. Martin, Ph.D., Asst. Prof.
J. R. Moore, Ph.D., Assoc. Prof.
R. A. Murray, Ph.D., Assoc. Prof.
H. D. Smith, Ph.D., Assoc. Prof.
D. A. Swope, Ph.D., Assoc. Prof.
W. P. Walker, M.S., Assoc. Prof.
J. W. Wysong, Ph.D., Assoc. Prof.

Agricultural and Extension Education

V. R. Cardozier, Ph.D., Prof. and Head
C. R. Smith, Ed.D., Assoc. Prof. and Dir. of Summer School
R. L. Johnson, Ph.D., Asst. Prof.

Agricultural Engineering

R. L. Green, Ph.D., Prof. and Head
George Burkhardt, M.S., Res. Prof.
K. E. Felton, M.S., Assoc. Prof.
G. W. Glenger, M.S., Assoc. Prof.
W. L. Harris, Ph.D., Asst. Prof.
F. V. Matthews, Jr., M.S., Asst. Prof.
P. N. Winn, M.S., Res. Assoc. Prof.

Agronomy

J. R. Miller, Ph.D., Assoc. Prof. of Soils and Head
J. H. Axley, Ph.D., Assoc. Prof. Soils
N. A. Clark, Ph.D., Asst. Prof. Crops
A. M. Decker, Jr., Ph.D., Assoc. Prof. Crops
J. H. Hoyert, Ph.D., Assoc. Prof. Tobacco
C. B. Kresge, Ph.D., Asst. Prof. Soils
J. A. Meade, Ph.D., Asst. Prof. Crops
J. A. Pomeroy, Ph.D., Asst. Prof. Soils
R. G. Rothgeb, Ph.D., Res. Prof. Crops
O. E. Street, Ph.D., Prof. Tobacco
Edward Strickling, Ph.D., Assoc. Prof. Soils

Animal Science

J. E. Foster, Ph.D., Prof. and Head
John Buric, Ph.D., Assoc. Prof.
W. W. Green, Ph.D., Prof.
E. C. Leffel, Ph.D., Assoc. Prof.
E. P. Young, Ph.D., Asst. Prof.

Botany

R. W. Krauss, Ph.D., Prof. Plant Phys.
Ronald Bamford, Ph.D., Dean Grad. Sch., Prof. and Head
A. A. Bell, Ph.D., Asst. Prof. Plant Path.
R. G. Brown, Ph.D., Assoc. Prof. Botany
R. A. Galloway, Ph.D., Asst. Prof. Plant Phys.
H. G. Gauch, Ph.D., Prof. Plant Phys.
W. L. Klarman, Ph.D., Asst. Prof. Plant Path.
L. R. Krusberg, Ph.D., Asst. Prof. Plant Path.
J. D. Lockard, Ph.D., Asst. Prof. Bot. and Ed.
D. T. Morgan, Jr., Ph.D., Prof. Bot.
O. D. Morgan, Jr., Ph.D., Assoc. Prof. Plant Path.
R. A. Paterson, Ph.D., Assoc. Prof. Bot.
R. D. Rappleye, Ph.D., Assoc. Prof. Bot.
H. D. Sisler, Ph.D., Assoc. Prof. Plant Path.
F. J. Williams, Ph.D., Asst. Prof. Plant Path.
J. B. Wilson, M.S., Asst. Prof. Plant Path.

Dairy Science

R. F. Davis, Ph.D., Prof. and Head
Wendell Arbuckle, Ph.D., Prof. Dairy Mfg.
J. L. Cason, Ph.D., Assoc. Prof. Dairy Sc.
R. N. Doetsch, Ph.D., Prof. Microbiology
R. W. Hemken, Ph.D., Assoc. Prof. Dairy Sc.
Mark Keeney, Ph.D., Prof. Dairy Mfg.
R. L. King, Ph.D., Assoc. Prof. Dairy Mfg.
J. F. Mattick, Ph.D., Assoc. Prof. Dairy Mfg.
W. E. Stewart, Ph.D., Asst. Prof. Dairy Sc.
J. H. Vandersall, Ph.D., Asst. Prof. Dairy Sc.
W. F. Williams, Ph.D., Asst. Prof. Dairy Mfg.

Editorial

Roy E. Miller, B.S. in Journalism, Editor
W. B. Neff, Pub. Editor

Entomology

W. E. Bickley, Ph.D., Prof. and Head
G. J. Abrams, M.S., Asst. Prof. Apiculture
L. P. Ditman, Ph.D., Prof.
Castillo Graham, Ph.D., Assoc. Prof.
F. P. Harrison, Ph.D., Asst. Prof.
Elizabeth E. Haviland, Ph.D., Asst. Prof.
J. C. Jones, Ph.D., Assoc. Prof.
E. R. Krestensen, Ph.D., Asst. Prof.
Allen Steinhauer, Ph.D., Asst. Prof.

Home Economics

Pela F. Braucher, M.S., Assoc. Prof. Foods and Nutrition

Horticulture

I. C. Haut, Ph.D., Prof. and Head, Dir. of Exp. Station
W. L. Hollis, Ph.D., Assoc. Prof. Veg. Crops
Amihud Kramer, Ph.D., Prof. Hort.
C. B. Link, Ph.D., Prof. Flor.
W. A. Matthews, M.S., Assoc. Prof. Veg. Crops
C. W. Reynolds, Ph.D., Assoc. Prof. Veg. Crops
L. E. Scott, Ph.D., Prof. Hort. Phys.
J. B. Shanks, Ph.D., Prof. Flor.
M. M. Shoemaker, M.S., Assoc. Prof.
R. J. Snyder, Ph.D., Assoc. Prof. Veg. Crops
F. C. Stark, Jr., Ph.D., Prof. Veg. Crops
A. H. Thompson, Ph.D., Prof. Pomol.
R. C. Wiley, Ph.D., Assoc. Prof. Hort. Processing

Poultry Science

C. S. Shaffner, Ph.D., Prof. and Head
G. F. Combs, Ph.D., Prof. Poultry Nut.
R. D. Creek, Ph.D., Assoc. Prof. Poultry Sc.
N. V. Helbacka, Ph.D., Assoc. Prof. Poultry Mktg.
G. D. Quigley, B.S., Assoc. Prof. Poultry Sc.
Mary S. Shorh, Sc.D., Res. Prof. Poultry Nut.
W. C. Supplee, Ph.D., Res. Assoc. Poultry Nut.
F. H. Wilcox, Ph.D., Assoc. Prof. Poultry Sc.

Veterinary Science

T. A. Ladson, D.V.M., Dir. L.S.S.C. and Head
R. J. Byrne, D.V.M., M.S., Assoc. Prof., Vet. Sc.
Cornelia M. Cotton, Ph.D., Assoc. Prof. Vet. Sc.
D. M. DeVolt, B.S., D.V.M., M.S., Prof. Avian Path.
B. C. Hatzioiols, D.V.M., D.A.H., Assoc. Prof. Path.
R. B. Johnson, A.B., Assoc. Prof., Vet. Sc.
I. M. Moulthrop, D.V.M., Prof. Path.

FINANCIAL STATEMENT — JULY 1, 1962 TO JUNE 30, 1963

Federal Funds

	Amended Hatch	Regional Research	Agri. Marketing Title II	
<i>Appropriation 1962-1963</i>				
<i>Balance brought forward June 30, 1962</i>	\$404,705.00	\$117,690.00	\$11,400.00	
			1,701.76	
	<u>\$404,705.00</u>	<u>\$117,690.00</u>	<u>\$13,101.76</u>	
<i>Receipts from sources other than Federal 1962-1963:</i>				
State Appropriations for Agricultural Investigation.....				For Agri. Investigations* \$1,286,687.00
Special Endowments, Fellowships, and Grants.....				60,680.54
Sales and Miscellaneous.....				160,918.22
				<u>\$1,508,285.76</u>
Balance brought forward July 1, 1962.....				32,670.32
TOTAL.....				<u>\$1,540,956.08</u>
<i>Expenditures:</i>				
Personal Services.....	\$281,632.87	\$ 72,478.48	\$ 7,250.13	\$1,006,900.08
Travel and Transportation of Persons.....	6,173.43	3,904.79	1,407.97	22,789.89
Equipment.....	32,738.21	12,196.14	31,263.04
Land and Structures.....	997.45	1,102.71	29,080.09
Personal Benefits.....
Supplies and Materials.....	69,584.88	19,957.13	1,016.39	285,909.56
All Other.....	12,301.42	7,355.39	463.18	107,000.91
	<u>\$403,428.26</u>	<u>\$116,994.64</u>	<u>\$10,137.67</u>	<u>\$1,482,943.57</u>
Balance June 30, 1963.....	1,276.74	695.36	2,964.09	58,012.51
TOTALS.....	<u>\$404,705.00</u>	<u>\$117,690.00</u>	<u>\$13,101.76</u>	<u>\$1,540,956.08</u>

*Including Offset Funds.

PUBLICATIONS

Bulletins

- A122 Drosophila Infestation of Tomatoes: Varietal Susceptibility and Processing Practices. R. M. Coan and L. P. Ditman. 26 pp. July, 1962.
- A123 The Susceptibility of the Red-banded Leaf Roller, *Argyrotaenia velutinana* (Walker), to TDE. E. R. Krestensen. 38 pp. March, 1963.
- A124 The Green Lacewings of the Genus *Chrysopa* in Maryland (Neuroptera: Chrysopidae). R. A. Bram and W. E. Bickley. 18 pp. June, 1963.
- A125 Maryland Agricultural Experiment Station Publications 1950-60. I. C. Haut. 44 pp. January, 1963
- A126 Effects of Fertilizer Rate Methods of Fertilizer Application and Plant Spacing on the Yield, Quality, Value, and Burn of Maryland Tobacco. C. G. McKee and O. E. Street. 22 pp. 1963.
- A127 Research for Maryland Agriculture. (74th Annual Report of the Maryland Agricultural Experiment Station.) I. C. Haut. 87 pp. June, 1962.
- A128 Silage Costs on Northeastern Dairy Farms. J. W. Wysong. 24 pp. June, 1963.
- A129 The Effects of Repeated Early-Season Boron Sprays on Maturity and Storage Life of Jonathan Apples, and on Carbohydrate Changes and Enzyme Activity in the Fruits. W. J. Bramlage and A. H. Thompson. 42 pp. 1963.

Scientific Journal Articles and

Miscellaneous Periodicals, Reports, Proceeds, Etc.

Department of Agricultural Economics

- 464 Impact on Maryland Agriculture of Proposed Freight Rate Adjustments on Grain. Paxton Marshall, George Stevens and Harold Smith. Multigraphed Circular 28 pp. July, 1962.
- 468 Trends and Adjustments on Talbot County Farms. Sidney Ishee. Multigraphed Circular. 53 pp. November, 1962.
- 478 The Effect of Size of Herd on the Organization and Operation of Frederick County Dairy Farms. J. W. Wysong and H. E. Reiley. Multigraphed Circular. 32 pp. January, 1963.
- 480 Maryland Tobacco Marketing Quota and Acreage Allotment Programs. G. M. Beal and K. C. Park. Multigraphed Circular. 55 pp. May, 1963.
- 483 Organization and Allocation of Agricultural Resources to Improve Net Farm Income on Small to Medium Size Farms on the Lower Eastern Shore of Maryland. J. W. Wysong and R. D. Porter. Multigraphed Circular. 122 pp. May, 1963.
- 485 Organization and Operation of Commercial Vegetable Farms on the Lower Eastern Shore of Maryland. J. W. Wysong and R. D. Porter. Multigraphed Circular. 57 pp. May, 1963.
- 487 Trends in the Value of Farm Products Sold in Maryland, by Districts and by Counties, Census Years 1944-59. J. W. Wysong. Multigraphed Circular 34 pp. 1963.
- 488 The Role of the Northeast in United States Farm Production. J. W. Wysong. Multigraphed Circular. 24 pp. 1963.

Department of Agricultural Engineering

- A1066 Punched Metal Truss Plates Used in Timber Joints. K. E. Felton and H. D. Bartlett. Mimeo. Circ. 13 pp. June, 1963.

Department of Agricultural and Extension Education

- 479 Training Received by Maryland First-Year 4-H Club Leaders. C. R. Smith. Multigraphed Circular. 19 pp. 1963.

Department of Agronomy

- A948 Response of Orchardgrass to Potassium and Nitrogen Fertilization on a Wickham Silt Loam. C. B. Kresge and S. E. Younts. Agron. Jour. 55:161-164. 1963.
- A949 High Frequency Titrimetry of Soils and Clays: Methodology, Theory and Nature of Ba-Mg Exchange Reaction. C. H. Simonson and J. H. Axley. Soil Sci. Soc. Proc. 27(1):26-31. Jan.-Feb., 1963.
- A975 Growth and Development of Yellow Foxtail and Giant Foxtail. P. W. Santelmann, J. A. Meade and R. A. Peters. Weeds 11(2):139-141. April, 1963.
- A1006 A Collaborative Study of the EDTA Method for Rating Agricultural Limestones. II. Relationship of Ratings and of Calcium Carbonate Content of Limestones to their Reactivity in Soil. C. W. Whittaker, J. H. Axley, Michael Peech, J. E. Steckel, E. O. McLean and A. S. Hunter. Agron. Jour. 55(4):355-358. 1963.
- A1012 A Collaborative Study of the EDTA Method for Rating Agricultural Limestones. I. Reproducibility of Ratings and Correlation with Chemical and Physical Characteristics of Materials. A. S. Hunter, Harlin Kenney, C. W. Whittaker, J. H. Axley, Michael Peech and J. E. Steckel. Agron. Jour. 55(4):351-354. 1963.
- A1014 Pseudo-Self-Compatibility and Segregation of Gametophytic Self-Incompatibility Alleles in Red Clover, *Trifolium Pratense* L. R. C. Leffel. Crop Sci. 3:337-380. 1963.
- A1025 Soybean Weed Control in Maryland. J. A. Meade and N. C. Glaze. Proc. N. E. Weed Conf. 17:255-259. 1963.
- A1039 Persistence of Ladino White Clover, *Trifolium repens* L. J. A. Schillinger, Jr., and R. C. Leffel. Agron. Jour. 56:11-14. 1964.
- A1040 Response of Plants to Air Pollutants. I. Effects of Ozone on Tobacco Plants Pre-Conditioned by Light and Temperature. H. A. Menser, H. E. Heggested, O. E. Street and R. N. Jeffrey. Plant Physiol. 38(5):605-609. 1963.
- A1041 Response of Plants to Air Pollutants. II. Effects of Ozone Concentration and Leaf Maturity on Injury to *Nicotiana tabacum* L. H. A. Menser, H. E. Heggested and O. E. Street. Phytopath. 53(11):1304-1308. 1963.
- A1050 Cytology of Pseudo-Self-Compatibility in Ladino White Clover, *Trifolium repens* L. M. M. Cohen and R. C. Leffel. Crop Sci. 3:430-433. 1963.
- 473 Effect of Plastics, in Modifying the Environment of Maryland Tobacco Plant Beds. J. H. Hoyert, C. G. McKee and O. E. Street. Multigraphed Circular. 6 pp. 1963.

Department of Animal Science

- A1042 Urea in Ruminant Nutrition. N. Satapathy and B. Panda. Indian Vet. Jour. 40(4):228-236. April, 1963.

Department of Botany

- A944 Utilization of Phosphorus Sources by Chlorella. R. A. Galloway and R. W. Krauss. Plant and Cell Physiol. (Special issue Studies on Micro-Algae and Photosyn. Bacteria) 569-575. 1963.
- A992 Injury and Recovery of Photosynthesis in Cells of Successive Developmental States: Temperature Effects. Constantine Sorokin. Plant and Cell Physiol. (Special Issue Studies on Micro-Algae and Photosyn. Bacteria.) 99-109. 1963.
- A1013 Asynapsis in Pepper Following X-Irradiation of the Pollen. D. T. Morgan, Jr. Cytologia, Internatl. Jour. Cytol. 28:102-107. 1963.
- A1044 Host Response to Nematode Infection. L. R. Krusberg. An. Rev. Phytopath. 1:219-224. 1963.
- A1053 The Capacity for Organic Synthesis in Cells of Successive Developmental Stages. Constantine Sorokin. Archib. Für Mikrobiologie. 46:29-43. 1963.

Department of Dairy Science

- A923 Bovine Ketosis: An Hietologic Study. II. The Thyroid Glands. B. C. Hatzioles and J. C. Shaw. Sonderdruck aus "Zentralblatt für Veterinarmedizin" Reihe A, Band X, Heft 2(1963), S. 163-181.
- A995 Growth Hormone Effects on Bovine Blood Plasma Fatty Acid Concentration and Metabolism. W. F. Williams, S. D. Lee, H. H. Head and J. Lynch. Jour. Dairy Sci. XLVI(12):1405-1408. 1963.
- A1008 Copper Distribution in Milk During Early Lactation. R. L. King and W. F. Williams. Jour. Dairy Sci. XLVI(1):11-13. January, 1963.
- A1009 Excretion of Progesterone and Its Metabolites in Milk, Urine and Feces. W. F. Williams. Jour. Dairy Sci. XLV(12):1541-1542. 1962.
- A1030 Oxidation of Milk Fat Globule Membrane Material. II. Relation of Ascorbic Acid and Membrane Concentrations. R. L. King. Jour. Dairy Sci. XLVI(4):267-274. April, 1963.
- A1043 Study of the Carbonyl Pattern of Sunlight Exposed Milk. L. A. Wishner and Mark Keeney. Jour. Dairy Sci. XLVI(8):785-788. 1963.
- 481 Maryland Feeding Standards for Dairy Cattle. R. F. Davis, R. W. Hemken, J. L. Cason, J. H. Vandersall and C. D. Caskey. Multigraphed Circ. 6 pp. 1963.
- 484 Comparison of Concentrated Sweetened Cream and Conventional Sources of Milk Fat on the Properties of Ice Cream. W. S. Arbuckle and R. W. Bell. Ice Cream Field. 5 pp. 1963.

Department of Entomology

- A981 Effect of Environmental Factors on Phosphamidon Degradation. R. E. Menzer and L. P. Ditman. Jour. Agrl. & Food Chem. 11(2):170. Mar.-Apr., 1963.
- A984 Phosphamidon Residue Studies on Various Crops. R. E. Menzer and L. P. Ditman. Jour. Econ. Entomol. 56(1):88-93. February, 1963.
- A990 A Simple Apparatus for Forced Copulation of Mosquitoes. R. E. Wheeler. Mosquito News. 22(4):402-403. December, 1962.
- A991 Rapid Method for Phosphamidon Residue Analysis. R. Anliker and R. E. Menzer. Jour. Agr. & Food Chem. 11(4):291. 1963.
- A994 Studies on the Total Hemocyte Count and Hemolymph Volume in *Periplaneta americana* (L) with Special Reference to the Last Moulting Cucle. Jour. Insect Physiol. 9:223-235. 1963. R. E. Wheeler.
- A1003 Behavior of NVE Virus in Two Species of Mosquitoes. R. M. Altman. Amer. Jour. Trop. Med. & Hygiene 12(3):425-434. May, 1963.
- A1007 Control of the Native Holly Leaf Miner, *Phytomyza ilicicola*. L. A. Kulp. Jour. Econ. Entomol. 56(6):737-739. 1963.
- A1032 An Evaluation of Several Insecticides Against Pests of Broccoli. M. F. Littleford and L. P. Ditman. Jour. Econ. Entomol. 56(6):766-767. 1963.
- A1035 Aphids on Strawberry in Maryland — Species, Seasonal Abundance and Control. T. L. Bissell, W. S. Murray and J. G. Kantzes. Trans. Penin. Hort. Soc. 52(5):45-52. 1962.
- A1038 An Evaluation of Potato Leafhopper Damage to Lima Beans. C. J. Eckenrode and L. P. Ditman. Jour. Econ. Entomol. 56(5):551-553. 1963.
- A1051 The Anatomy of a Naturally Occurring Adult Female *Aedes aegypti* (Linnaeus) J. C. Jones. Mosquito News 23(2). June, 1963.
- A1059 A Technique for Artificial Insemination of *Aedes Mosquitoes*. R. E. Wheeler and J. C. Jones. Mosquito News 23(4). 1963.
- A1062 Effect of Gallling by *Ditylenchus Dipsaci* on Pectins in Alfalfa. L. R. Krusberg. Nematologica 9:341-346. 1963.
- 474 Effect of Fungicidal Sprays on Disease Control and Yield of Cantaloupes on the Eastern Shore of Maryland, 1962. J. G. Kantzes and J. M. Wells. Trans. Penin. Hort. Soc. 52(5):62-65. 1962.
- 475 Disease Control of Cucumber with Special Emphasis on Control of Scab on the Eastern Shore, 1962. J. G. Kantzes, W. A. Matthews and J. M. Wells. Trans. Penin. Hort. Soc. 52(5):53-57. 1962.

- 476 Five Year Results of Spraying Tomatoes. J. G. Kantzes and L. O. Weaver. Trans. Penin. Hort. Soc. 52(5):66-69. 1962.
- 477 A Rhizoctonia Leaf Blight of Strawberry. O. D. Morgan, J. G. Kantzes, L. O. Weaver and W. F. Jeffers. Plant Dis. Reporter 47(6):463-465. June 15, 1963.
- A1072 Studies on Reproductive Physiology in Mosquitoes. J. C. Jones. Proc. 7th Internatl. Congresses of Tropical Med. & Malaria, Rio de Janeiro, Brazil. 1963.
- 466 Control of Orchard Mites with Remarks on the Performance of Dusts, 3X, and 8X Concentrates on the Control of Apple Pests. E. R. Krestensen and Castillo Graham. Trans. Penin. Hort. Soc. 52(5):34-39. 1962.

Department of Horticulture

- 470 A Gradient Distributor for the Application of Granular Materials. J. D. Riggleman, G. J. Burkhardt and F. C. Stark. Proc. N. E. Weed Control Conf. 17:73. 1963.
- 482 Continuous Counting and Sorting of Defects. Amihud Kramer. Food Tech. 1963. (Abstract only published)
- A924 The Practical Application of the Shear-Press for Determining Fibrousness of Raw and Canned Asparagus. G. S. Warner, E. E. Meschter, H. P. Lacey and Amihud Kramer. Food Tech. 17(1):81-86. January, 1963.
- A968 The Number of Tasters Required to Determine Consumers Preference with Special Reference to Fruit Drinks. Amihud Kramer, F. W. Cooler, Jane Cooler and Mildred Modery. Food Technol. 17(3):86-91. 1963.
- A1004 The Influence of Photoperiod on the Rooting of Cuttings of Some Woody Ornamental Plants. R. L. Baker and C. B. Link. Proc. Amer. Soc. Hort. Sci. 82:596-601. 1963.
- A1010 Gas-Liquid Chromatography Studies with Strawberries. E. M. Ahmed and L. E. Scott. Proc. Amer. Soc. Hort. Sci. 82:299-310. 1963.
- A1020 Chemical Weed Control in Seeded Cantaloupes. J. D. Riggleman and F. C. Stark. Proc. N. E. Weed Control Conf. 17:24-28. 1963.
- A1021 Chemical Weed Control in Sweet Potatoes. J. D. Riggleman and W. A. Matthews. Proc. N. E. Weed Control Conf. 17:58-62. 1963.
- A1022 Chemical Weed Control in Transplanted Tomatoes. J. D. Riggleman and H. A. Hunter. Proc. N. E. Weed Control Conf. 17:104-109. 1963.
- A1023 Weed Control in Newly Established Strawberry Plantings. G. J. Stadelbacher and J. D. Riggleman. Proc. N. E. Weed Control Conf. 17:142-143. 1963.
- A1028 The Relation of Pectic Substances to Firmness of Processed Sweet Potatoes. R. A. Baumgardner and L. E. Scott. Proc. Amer. Soc. Hort. Sci. 83:629-640. 1963.

Department of Poultry Science

- A940 Genetic Control of Serum Alkaline Phosphatase in the Chicken. F. H. Wilcox. Jour. Exp. Zool. 152(2):195-204. March, 1963.
- A941 The Lipid Composition of *Tetrahymena pyriformis* and *Trichomonas gallinae*. Mary S. Shorb. Trans. First Conf. Protozool. 5 pp. 1963.
- A945 Estimates of Genetic Parameters of Serum Cholesterol Level. F. H. Wilcox, F. L. Chermis, Jr., L. D. VanVleck, W. R. Harvey and C. S. Shaffner. Poultry Sci. XLII(1):37-42. January, 1963.
- A983 Stachybotryotoxiosis of Chicks. G. Schumaier, H. M. DeVolt, N. C. Laffer and R. D. Creek. Poultry Sci. XLII(1):70-74. January, 1963.
- A986 Studies on Egg Yolk Cholesterol. I. Genetic Variation and Some Phenotypic Correlations in a Random Bred Population. P. C. Harris and F. H. Wilcox. Poultry Sci. XLII(1):179-182. January, 1963.
- A987 Studies on Egg Yolk Cholesterol. 2. Influence of Season. P. C. Harris and F. H. Wilcox. Poultry Sci. XLII(1):182-185. January, 1963.
- A988 Studies on Egg Yolk Cholesterol. 3. Effect of Dietary Cholesterol. P. C. Harris and F. H. Wilcox. Poultry Sci. XLII(1):186-189. January, 1963.

- A996 An Examination of Some Interpretations of Molt with Added Data from Progesterone and Thyroxine. Mary Juhn. *The Wilson Bulletin* 75(2):191-197. June 25, 1963.
- A997 Developmental Dissociation of the Feather Tissues in "Ragged Wing" Chicks. Mary Juhn and C. S. Shaffner. *Jour. Exp. Zool.* 150(2):155-163. July, 1962.
- A998 Judging is Not Judging. G. D. Quigley. *Poultry Sci.* XLII(1):225-227. January, 1963.
- A999 Evidence of an Antagonistic Relationship Between Dietary Cadmium and Zinc. W. C. Supplee. *Sci.* 139(3550):119-120. January, 1963.
- A1000 Anhydrous Dicalcium Phosphate as a Source of Phosphorus in Poult. Diets. W. C. Supplee. *Poultry Sci.* XLI(6):1984-1985. November, 1962.
- A1001 Alkaline Phosphatase, Feathering and Bone Ash in Chicks as Affected by Hemin. W. O. Pollard, Mary S. Shorb and R. D. Creek. *Proc. Soc. Exp. Biol. Med.* 112:478-480. 1963.
- A1002 Histology of Osteodystrophy in Hemin Treated Chicks. W. O. Pollard, Mary S. Shorb and R. D. Creek. *Proc. Soc. Exp. Biol. Med.* 112:480-483. 1963.
- A1011 Plasma CO₂ Capacity of Laying Hens. N. V. Helbacka and J. L. Casterline, Jr., *Poultry Sci.* 42(2):450-451. March, 1963.
- A1018 Comparison of Growth Response of Chicks to Virginiamycin and Other Antibiotics. G. F. Combs and E. H. Bossard. *Poultry Sci.* XLII(3):681-685. May, 1963.
- A1024 Performance of Lines Selected for High and Low Serum Cholesterol. F. H. Wilcox and C. S. Shaffner. *Poultry Sci.* XLII(4):1033-1035. 1963.
- A1037 The Effect of High CO₂ Atmosphere on the Laying Hen. N. V. Helbacka, J. L. Casterline, Jr., and C. J. Smith. *Poultry Sci.* XLII(5):1082-1084. 1963.
- A1045 The Effect of Excess Dietary Protein on the Need for Folic Acid by the Chick. R. D. Creek and Valeria Vasaitis. *Poultry Sci.* XLII(5):1136-1141. 1963.
- A1046 Failure to Prevent Certain Types of Perosis with Succinic and Nucleic Acids. R. D. Creek and Valeria Vasaitis. *Poultry Sci.* XLII(5):1134-1136. 1963.
- A1047 Impaired Antibody Production in Chicks Fed Diets Low in Vitamin A, Pantothenic Acid or Riboflavin. B. Panda and G. F. Combs. *Proc. Soc. Exp. Biol. and Med.* 113:530-534. 1963.
- A1049 Origin of an Increased Serum Alkaline Phosphatase in Chicks. H. R. Wilson and F. H. Wilcox. *Proc. Soc. Exp. Biol. Med.* 113:413-415. 1963.
- A1054 Effect of Exogenous and Endogenous Androgen on the Histology of Wolffian Ducts of Pullets. B. Panda and C. S. Shaffner. *The Indian Vet. Jour.* 40(5):259-262. May, 1963.
- A1055 The Effect of Thalidomide Treatment of Hens on Embryonic Development and Fertility. Mary S. Shorb, Clifford Smith, Valeria Vasaitis, Pauline G. Lund and William Pollard. *Proc. Soc. Exp. Biol. and Med.* 113:619-622. 1963.
- A1056 Estimates of Correlations Between Serum Alkaline Phosphatase Level and Productive Traits. F. H. Wilcox, L. D. VanVleck and W. R. Harvey. *Poultry Sci.* XLII(6):1457-1458. 1963.
- A1061 Use of Co-Ral as a Systemic Insecticide for Layers. G. D. Quigley and W. C. Harding, Jr. *Poultry Sci.* XLII(5):1247-1248. 1963.
- 465 Summary of Maryland Broiler Trials Involving Different Protein and Amino Acid Levels During the Starting and Finishing Periods. G. F. Combs and J. L. Nicholson. *Feedstuffs* 34(43):18-24. October 27, 1962.
- 467 Report of Maryland Broiler Trial S-38. G. F. Combs and J. L. Nicholson. *Feedstuffs* 35(1):36. January, 1963.

Department of Veterinary Science

- 486 Specifications for Linear Programming of Broiler Rations. G. F. Combs, J. L. Milligan and J. L. Martin. *Feedstuffs* 35(33):44. 1963.
- A973 Preliminary Studies on the Technique of Passive Hemagglutination with the Infectious Bronchitis Virus of Chickens. P. L. Vasington, N. C. Laffer, A. P. Holst and H. M. DeVolt. *Poultry Sci.* XLII(3):634-636. May, 1963.

- A1017 A Preliminary Study on Tissue Cultures of Bovine Lymphosarcoma. B. C. Hatzios and S. C. Chang. Annals New York Academy Sci. 108:1214-1230. 1963.
- A1029 Development and Ether Sensitivity of Infectious Bronchitis Virus of Chickens in Cell Cultures. S. B. Mohanty and S. C. Chang. Amer. Jour. Vet. Res. 24(101):822-826. 1963.
- A1034 The Isolation of *Vibrio Fetus* from Bovine Preputial Fluid Using Millipore Filters and an Antibiotic Medium. V. M. Shepler, G. J. Plumer and J. E. Faber. Amer. Jour. Vet. Res. 24:749-755. 1963.
- A1036 The Combined Effect of *Pastuerella multocida* and Myxovirus parainfluenza-3 Upon Calves. F. M. Hetrick, S. C. Chang, R. J. Byrne and P. A. Hansen. Amer. Jour. Vet. Res. 24(102):939-947. 1963.

CURRENT PROJECTS

(These are projects and not publications available to the public)

Department of Agricultural Economics

Project

- A-18-ao An Analysis of Forage Storage on Dairy Farms. J. W. Wysong.
- A-18-ap Economic Profitability of Vegetable Production in Maryland. Sidney Ishee, J. M. Curtis, and F. D. Gray.
- A-18-ar Economies of Scale in the Production of Fluid Milk on Specialized Dairy Farms in Maryland. J. W. Wysong and J. P. Marshall.
- A-18-as An Analysis of Past, Present and Prospective Levels and Variability of Prices of Maryland Farm Products and Farm Resources. J. W. Wysong.
- A-18-at The Acquisition and Use of Capital on Large Farms in Selected Type of Farming Areas in Maryland. R. A. Murray.
- A-18-au Dairy Adjustments and Supply Response in Maryland and the Northeast. J. P. Marshall, J. W. Wysong, and G. E. Frick.
- A-18-av An Analysis of the Economic Aspects of Beef Cattle Production in Maryland. Sidney Ishee and G. E. Patty.
- A-18-aw Estimating the Returns to Inputs of Capital and Labor on Maryland Cash Grain and Tobacco Farms. J. P. Marshall.
- A-18-ax Organization of the World's Agricultural Resources. P. W. Foster and D. Sobers.
- A-19-y Assessment and Taxation of Farmland in the Rural-Urban Fringe in Maryland. F. D. Stocker and P. W. House.
- A-19-z An Analysis of Practical Procedure for Equitable Taxation of Agricultural Land and Forest Tracts in Maryland. W. P. Walker and R. A. Murray.
- A-26-bc Adjustments of Maryland Milk Processing-Distribution Systems and Practices to Changing Condition. G. M. Beal, L. C. O'Day, and Y. Rao.
- A-26-bd Adjustments in Broiler Industry Related to Area Competition and Market Demand. H. D. Smith, J. E. Martin, J. M. Curtis, and Anthony Ferrise.
- A-26-bf Improving Auction Warehouse Facilities and Methods of Marketing Maryland Tobacco. G. M. Beal and R. J. Beiter and Graduate Assistant.
- A-26-bg Analysis of the Impact of Farmer Cooperatives on the Agricultural Economy in Maryland. R. J. Beiter.
- A-26-bh Trends Pointing to Future Consumption and Market Potential for Meats in the Northeast. H. D. Smith, R. M. Jones and J. N. Smith.
- A-26-bi The Effects of Changes in Transportation Rates on the Delmarva Poultry Industry. J. E. Martin, H. D. Smith and G. F. Combs.
- A-26-bj Changes in the Structure of the Northeast Processed Vegetable Industry. D. A. Swope, J. E. Martin, L. C. O'Day, and J. M. Curtis.
- A-26-bk Impact of the Chesapeake Bay Bridge-Tunnel on the Marketing of Soybeans, Corn and Feed Derivatives of these Grains, Through the Port of Baltimore. P. W. Foster and J. Hutchinson.
- QA-58-s Effect of Alternative Vining Methods on Processing Cost and Quality of Lima Beans. D. A. Swope, B. A. Twigg, R. S. Fox, and L. C. O'Day.
- A-26-bl Changing Structure and Performance of the Northeastern Markets for Grain. J. E. Martin and W. G. Heid, Jr.

Department of Agricultural and Extension Education

- T-6 Identification of High School Educational Experiences Affecting the Success of Students in the College of Agriculture. C. R. Smith.
- T-8 A Study of First Year 4-H Club Leaders in Maryland. C. R. Smith.
- T-9 Relationship of Undergraduate Academic Achievement in College and Success in Teaching Vocational Agriculture. V. R. Cardozier.

Department of Agricultural Engineering

- R-16 Pneumatic Handling of Chopped Forage. W. L. Harris, G. J. Burkhardt, K. E. Felton, R. L. Green, E. W. Martin, N. E. Collins, and J. E. Foster.
- R-18 Development of Equipment and Improved Methods for Harvesting Sweet Potatoes. G. J. Burkhardt, L. E. Scott, and E. W. Martin.
- R-20 Principles of Separating Crop from Soil in Harvesting Root Crops. G. J. Burkhardt.
- R-21 Development and Construction of Specialized Facilities and Equipment for Use in Agricultural Research. G. J. Burkhardt, W. C. Schaefer, E. W. Martin, J. A. Meade, R. W. Krauss, D. Shriver, J. D. Riggleman, and E. Ahmed.
- RB-11-g Tobacco Housing. (In cooperation with the Department of Agronomy) O. E. Street, John Hoyert, P. N. Winn, Jr., G. J. Burkhardt, R. L. Green, E. Martin, and N. Martin.

Department of Agronomy

- 3-43 Soybean Varietal Improvement. R. C. Leffel, C. E. Bass, and J. L. Newcomer.
- 3-50 Breeding for Better Dent Corn. R. G. Rothgeb and N. A. Clark.
- 3-56-g Ladino Clover Breeding, Disease and Insect Investigations. R. C. Leffel.
- 3-56-i Breeding and Evaluation of Improved Varieties of Orchard Grass and Other Forage Crops. R. C. Leffel.
- 3-56-j Pasture Species for Beef Production. A. M. Decker and J. E. Foster.
- 3-66 Wheat Breeding and Evaluation. R. G. Rothgeb, J. L. Newcomer, and J. H. Axley.
- 3-67 Varietal Improvement in Barley and Oats. R. G. Rothgeb and Assistants.
- 3-68 Effect of Rotational Practices Involving Various Legumes on the Growth, Quality and Composition of Maryland Tobacco. J. H. Mills, C. G. McKee, and O. E. Street.
- 3-72 Evaluation of Varietal Purity and Identity of Seeds of Improved Strains of Alfalfa. J. L. Newcomer.
- 3-73 Clipping Management Effects on the Productivity and Persistence of Perennial Grasses Under Two Nitrogen Levels. A. M. Decker, N. A. Clark, and J. T. Raese.
- 3-74 The Effects of Nitrogen Rates and Clipping Frequency on the Performance of Midland Bermudagrass (*Cynodon dactylon* (L) Pers) A. M. Decker.
- 3-75 Use of Sod-seeded Forage Crops to Supplement Existing Permanent Pastures. A. M. Decker, W. C. Hulburt, and A. L. Steinhauer.
- 3-76 Red Clover Breeding Investigations. R. C. Leffel.
- 3-77 Forage Crop Variety Evaluation in Maryland. R. C. Leffel, A. M. Decker, and N. A. Clark.
- 3-78 The Control of Weeds in Cultivated Crops, Turf and Brush. J. A. Meade, N. C. Glaze, and R. Koontz.
- 3-79 Use of Herbicides to Control Weeds in Forage. J. A. Meade and N. C. Glaze.
- 3-80 Physiological and Ecological Investigations of the Effect of the Herbicides on Plants. J. A. Meade and N. C. Glaze.
- 3-81 Preplant Herbicides for Tobacco Plant Beds, and their Influence on Seedling Production. O. E. Street, C. G. McKee, J. D. Bowling, J. E. McMurtrey, Jr., J. H. Hoyert, and H. A. Menser, Jr.
- 3-82 Fertility and Clipping Management Effects in the Productivity and Persistence of Annual Pasture Grasses. N. A. Clark.
- 3-83 Forage Crop Development Under Controlled Soil Temperature Conditions. A. M. Decker and Graduate Students.
- 3-85 Late Planting and Winter Survival in Oats. R. G. Rothgeb and Assistants.
- 3-86 A Comparison of Silage Corn Grown Under High and Low Rates of Nitrogen When Fed to Milking Cows. N. A. Clark, J. W. Vandersall, and R. W. Hemken.
- 3-87 Factors Contributing to Maximum Production in Maryland Tobacco. O. E. Street, J. H. Hoyert, C. G. McKee, J. E. McCartney, Jr., Thos. Thies.

- B-94 Studies of Some Fundamental Physiochemical Relationships of Tobacco with Respect to Cultural, Fertilization, Curing and Fermentation Practices. O. E. Street, R. G. Rothgeb, J. H. Hoyert, C. G. McKee, D. D. Tyrer, P. N. Winn, R. L. Green, T. C. Tso, and Thos. Thies.
- B-93 Response of Midland Bermuda Grass to Urea and Ammonium Nitrate Applied at Different Times and Rates. A. M. Decker and J. R. Miller.
- B-89 The Effects of Physical Characteristics of Herbicides on Efficiency and Mode of Action When Used on Corn and Soybeans. J. A. Meade, N. C. Glaze, and R. Koontz.
- B-95 Germination, Development and Competitiveness of Crabgrass (*Digitaria* spp.) Under Varying Environmental Conditions. J. A. Meade and N. C. Glaze.
- BG-2 Grazing Study with Lactating Dairy Cows on Summer Annual Pastures. N. A. Clark, J. H. Vandersall, and R. W. Hemken.
- BOQR-84 Climatological Relationship to Plant Growth. O. E. Street, A. M. Decker, Jr., Edward Strickling, J. H. Hoyert, Jr., C. W. Reynolds, P. N. Winn, Jr., R. L. Green, H. A. Heggested, H. A. Menser, Jr., J. K. McGuire, and A. D. Peterson.
- O-48 Morphologic Studies of Maryland Soils as Related to Classification and Correlation. J. A. Pomeroy and W. F. Sledjeski.
- O-55 Soil Test Studies. J. H. Axley.
- O-56 Factors Affecting the Formation and Destruction of Soil Aggregates. Edward Strickling, R. Gifford, A. W. Conaway, and G. J. Malley.
- O-57 A Study of Ammonium as a Fertilizer and Ammonium Retention in Soils. J. A. Axley.
- O-62 The Response of Forages and Certain Grain Crops of Fertilizers as Related to Rates and Ratios and Methods of Application. J. H. Axley.
- O-63 Response of Orchard Grass to Various Sources of Nitrogen and Their Time of Application. C. B. Kresge.
- O-64 Response of Bermudagrass to Various Rates and Ratios of Potassium and Nitrogen Fertilization. C. B. Kresge, A. M. Decker, and N. A. Clark.
- O-65 Legume Grass Mixtures in Relation to Differential Nitrogen Fertilization. C. B. Kresge.
- O-70 Relationship of Soil and Weather to Consumptive Use of Soil Moisture by Selected Field Crops. Edward Strickling, Neir Clark, and C. Stottlemeyer.
- O-71 Nutrient Balance in Orchardgrass as Related to Differential Fertilization. C. B. Kresge and V. A. Bandel.

Department of Animal Science

- C-21 The Effect of Specific Metabolites Upon Growth Rate and General Condition of Sheep. E. C. Leffel and R. W. Farmer.
- C-25-a The Effects of Roughage Preparation. E. C. Leffel, A. Adare, and 'B. B. Mahapatro.
- C-31-b Comparison of Morca versus Oil Meal as a Supplement for Feeding Weaned Beef Calves. J. Buric, J. E. Foster, and E. C. Leffel.
- C-33 A Study of the Effect of Menhaden Fish Meal on the Quality of Protein of Swine Diets and on Total Crude Protein Requirements for Growth of Swine. E. P. Young, J. E. Foster, D. G. Snyder, and Robert Kifer.
- C-34 A Study of the Nutritional and Physiological Influences on Variability of Ovulation Rate and Embryonic Survival in Swine. E. P. Young, W. W. Green, and J. E. Foster.
- C-35 Studies on the Efficiency and Composition of Growth in Swine as Affected by Protein and Energy Consumption. E. P. Young, E. C. Leffel, and G. F. Combs.
- C-36 A Study of Factors Affecting the Utilization of Non-protein Nitrogen in High Roughage Diets for Ruminants. E. C. Leffel, N. Satapathy, and R. W. Farmer.
- C-37 A Comparison of Different Roughage-Grain Ratios for Optimum Gains for Developing Weanling Beef Heifers. John Buric, J. E. Foster, and E. C. Leffel.
- C-38 A Study of Factors that Influence Feed Consumption by Suckling Pigs. E. P. Young, R. E. Fowler, and J. E. Foster.
- C-39 Analyses of Records of Beef Cattle Herds in Maryland. W. W. Green, John Buric, J. E. Foster, J. Lingle, and J. L. Carmon.

- 3-40 A Study of the Use of Measurements for the Evaluation of Beef Breeding Cattle. W. W. Green, W. R. Stevens, John Buric, J. E. Foster, Joe Lochte, and J. L. Carmon.
- 3-41 A Study of Variations in Values of Criteria Used in Selection Indices for Beef Cattle. John Buric, J. E. Foster, and W. W. Green.
- 3-42 A Study of Rates of Ruminant Digestion and Absorption from the Rumen. E. C. Leffel, M. H. Abbassy, and R. W. Farmer.

Department of Botany

- 3-12 The Native Plants of Maryland, Their Occurrence, Distribution and Economic Importance. R. G. Brown, M. L. Brown, and J. L. Jones.
- 3-17 Forest Tree Improvement by Chromosome Doubling of Haploid Sporophytes. R. D. Rappleye.
- 3-18 Genetic Control of the First Division Association of Homologous Chromosomes and Fertility in *Zea mays* and *Capsicum frutescens*. D. T. Morgan and R. L. Baker.
- 3-19 Anatomical Physiological and Ecological Studies on *Myriophyllum Spicatum* L. R. G. Brown, R. D. Rappleye, and Graduate Asst.
- 3-91 Fungicidal Materials on Cellular Metabolism and Their Usefulness for the Field Control of Vegetable Diseases. H. D. Sisler, J. G. Kantzes, A. A. Bell, and Grad. Assts.
- 3-93 Treatment of Soil and Underground Parts of Plants for the Control of Plant Diseases. O. D. Morgan, J. G. Kantzes, L. R. Krusberg, A. A. Bell, F. J. Williams, W. L. Klarman, R. C. Leffel, and Assistants.
- 3-95 Development of Improved Strains of Maryland Tobacco Resistant to Diseases. O. D. Morgan, O. E. Street, J. Hoyert, H. E. Heggsted, John Mills, C. G. McKee, H. A. Skoog, and Assistants.
- 3-97 Physiology of Plant Parasitic Nematodes and the Plant Nematode Interaction. L. R. Krusberg, R. F. Myers, R. K. Howell, and J. M. Taylor.
- 3-98 Identification, Characterization and Control of Certain Viruses Affecting Economic Plants in Maryland. H. D. Sisler, O. D. Morgan, A. A. Bell, and J. Wells.
- 3-99 The Nature and Control of Root Rots Involved in Decline of Boxwood and Other Woody Ornamental Plants in Maryland. J. B. Wilson and L. R. Krusberg.
- 3-100 Nature and Control of Major Field and Storage Diseases of Sweet Potatoes in Maryland. J. G. Kantzes and J. M. Wells.
- 3-8-c Biophysical and Biochemical Factors in Plant Nutrition. H. G. Gauch, R. W. Krauss, Raymond Galloway, and John Bowen.

Department of Dairy Science

- 3-34 Chemical Changes in Milk Fat as Related to the Flavor of the Milk. R. L. King.
- 3-35 The Analysis of Dairy Products. Mark Keeney, I. Katz, and J. F. Mattick.
- 3-37 Physiology of Metabolic Diseases of Cattle. W. F. Williams, J. D. Connolly, and W. E. Stewart.
- 3-39 Studies on the Mode of Digestion, Absorption and Utilization of Feeds by Ruminants and their Associated Bacteria. W. E. Stewart, J. Nicolai, H. F. Downey, R. N. Dotsch, and G. J. Hageage.
- 3-40 Influence of High Temperature Heat Treatment on Certain Physical and Chemical Properties of Milk. Mark Keeney, J. E. Keensman, and C. B. Love.
- 3-42 Methods of Processing and Other Factors Affecting the Quality of Ice Cream. W. S. Arbuckle.
- 3-46 The Relationship of the Hypophyseal Growth Hormone and of the Pituitary-Adrenal System to the Productive Capacity of Dairy Cattle for Reproduction and Milk Production. W. F. Williams, J. D. Connolly, and H. H. Lead.

- G-47 The Nutritive Evaluation of Forages. R. W. Hemken, N. A. Clark, D. T. Buchman, and R. F. Davis.
- G-48 Flavor Quality of Concentrated Milk Products as a Factor in Milk Utilization and Marketing. Mark Keeney and Ira Katz.
- G-50 The Physiology of Progesterone Metabolism. W. F. Williams, G. D. Turner, and J. C. Lynch.
- G-51 A Study of the Effects of Pelleting and Heating of Feeds Upon Body Composition, Growth and Milk Secretion in Ruminants. J. H. Vandersall, R. W. Hemken, and R. L. King.
- G-52 A Study of Factors Affecting the Voluntary Intake, Availability and Utilization of Nutrients in Forages for Growth and Milk Production. R. W. Hemken, J. H. Vandersall, N. A. Clark, and R. F. Davis.
- G-53 A Study of the Development, Improvement or Standardization of Manufacturing Processes for the Production of Various Cheeses and the Effect of Specific Factors on the Flavor, Body and Texture of these Cheeses. J. F. Mattick.
- G-54 Analyses of Production and Feed Data from Dairy Records. J. L. Cason.
- GC-45 Studies of the Physiological and Biochemical Nature of Bloat. W. E. Stewart, E. C. Leffel, and B. B. Mahapatra.
- BG-1 The Comparison of Nitrogen Fertilized Grasses with a Grass-Legume Mixture for Lactating Dairy Cows. N. A. Clark, A. M. Decker, R. W. Hemken, and J. I. Leslie.

Department of Entomology

- H-29-n Chemical Control of Insect Pests of Sweet Corn. L. P. Ditman and F. P. Harrison.
- H-46-e Concentrated Pesticide Sprays, Evaluation of New Insecticides on Vegetable Crops. L. P. Ditman, G. J. Burkhardt, and Graduate Students.
- H-48 Control of the Codling Moth and Careful Observations on Possibility of Resistant Strains. W. E. Bickley, Castillo Graham, and E. R. Krestensen.
- H-56 Patuxent Project on the Effect of Soil Conservation Upon Insect Populations. E. N. Cory, L. P. Ditman, and H. B. Owens.
- H-61 The Biology and Distribution of *Macropsis Trimaculata* Fitch. W. E. Bickley, Castillo Graham, and E. R. Krestensen.
- H-64 An Evaluation of the Effectiveness of Commercial Insect Control Practices on Canning Crops. L. P. Ditman.
- H-67 Insecticidal Residues on Vegetable and Forage Crops. L. P. Ditman, R. E. Menzer, and Mrs. Katherine Nelson.
- H-69 Identification and Control of the Various Species of Mites Causing Damage to Apple Orchards. W. E. Bickley, Castillo Graham, and E. R. Krestensen.
- H-71-d Alfalfa Insects, Their Biology and Control. A. L. Steinhauer.
- H-72 Physiology of Insect Reproduction. J. C. Jones and E. S. Krafsur.
- H-73-a The Mosquito Fauna in Selected Swamps, Marshes and Impoundments. W. E. Bickley and Graduate Students.
- H-74 Biology and Control of Tobacco Insects. F. P. Harrison.
- H-76 Comparative Morphology and Physiology of Insect Blood Cells. J. C. Jones, Mrs. D. P. Liu, R. E. Wheeler, and S. S. Kumar.
- H-77 The Susceptibility of the Red-Banded Leaf Roller *Argyrotaenia velutinana* (Wlkr.) to TDE. E. R. Krestensen, C. Graham, and W. E. Bickley.
- H-78 Metabolism of Essential Nutrients and Insecticidal Chemicals in Insects. A. L. Steinhauer, and Graduate Students.
- H-79 Classification of Green Lacewings (Chrysopidae: neuroptera). W. E. Bickley and R. A. Bram.
- H-80 Classification of the Neotropical Mosquitoes of the Subgenus *Culex*. W. E. Bickley and R. A. Bram.
- H-81 Utilization of the Polyhedrosis Virus for Commercial Control of the Cabbage Looper. L. P. Ditman, R. N. Hofmaster, and L. A. Kulp.
- H-82 Chemosterilization of Insects. W. E. Bickley and Graduate Student.

College of Home Economics

- Y-1 The Effects of Different Quality and/or Quantities of Dietary Protein on Serum Lipid Levels. Pela Braucher, Virginia Dawson, Genevieve Watkins, E. C. Cox, and L. M. Dyke.
- Y-2 Measurements of Air Permeability on Selected Garment Fabrics Before and with Wear. Eleanor Young and T. Faye Mitchell.

Department of Horticulture

- 74-a Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Greenhouse Potted Plants. J. B. Shanks, C. B. Link, and Frank Marousky.
- 74-b Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Greenhouse Cut Flower Crops. C. B. Link, J. B. Shanks, James Swasey, and Frank Gouin.
- 79-1 Physiological Differences of Winter and Summer Flowering Varieties of Snapdragons as Related to Growth and Flower Quality. C. B. Link, J. B. Shanks, and K. C. Sanderson.
- 79-m Relationship of the Mineral Nutrients and of Nutrient Levels to the Growth and Development of Certain Woody Ornamental Plants Growing in Containers. C. B. Link and Frank Gouin.
- 73 Adaptation of Fruit Varieties and New Seedlings to Maryland. I. C. Haut, F. J. Lawrence, and A. H. Thompson.
- 74 Environmental Factors and Cultural Practices in Relation to the Growth and Fruiting Responses of Fruits. A. H. Thompson, B. L. Rogers, L. E. Scott, F. J. Lawrence, I. C. Haut, and H. S. Todd.
- 74-b Chemical Thinning of Apples and Peaches. A. H. Thompson and B. L. Rogers.
- 79-a Relation of the Level of Mineral Nutrients in the Plant to Growth and Fruiting of the Strawberry with Particular Reference to Nitrogen. L. E. Scott, Glenn Stadelbacher, and H. S. Todd.
- 79-e Mineral Nutrition of the Apple with Reference to the Development of Cork Spot and to Respiration, Enzyme Activity and Storage Life. A. H. Thompson, B. L. Rogers, W. J. Bramlage, J. A. Barden, and H. G. Gauch.
- 2-58-a Rapid Nutritive Evaluation of Processed Vegetables. Amihud Kramer, L. E. Scott, and E. M. Ahmed.
- 2-58-f Development of Objective Grades and Standards and Quality Control Method for Vegetables. Amihud Kramer, B. A. Twigg, R. C. Wiley, E. M. Ahmed, Mildred Modery, F. W. Cooler, and Jane Cooler.
- 2-58-k Development of Specifications for Canned Food Quality. A. Kramer, B. A. Twigg, R. C. Wiley, W. W. Anderson, R. Lappen, S. Frear, and M. McNiminy.
- 2-58-m Development of New Products and Improved Processing Methods. R. C. Wiley, A. Kramer, B. A. Twigg, J. Cooler, M. Modery, T. Chase, and J. Collins.
- 2-58-n Suitability of New Varieties of Horticultural Crops for Canning and Freezing. W. L. Hollis, A. Kramer, B. A. Twigg, F. C. Stark, and L. E. Scott.
- 2-58-p Quality Improvement of Canned Apple Slices and Sauce Through Studies of the Relation of Water Insoluble Constituents of the Fresh Fruit to the Textural Quality of the Processed Product. R. C. Wiley, A. H. Thompson, M. Modery, D. White, and J. L. Collins.
- 2-58-q Bulk Packaging and Shipping of Raw Vegetables. Amihud Kramer, B. A. Twigg, R. C. Wiley, E. M. Ahmed, F. W. Cooler, and S. Angel.
- 2-74 A Study of Regional Adaptation of Certain Vegetable Crops and Varieties in Maryland. W. L. Hollis, F. C. Stark, C. W. Reynolds, and L. E. Scott.
- 2-77 Crop Management Studies with Vegetable Crops. W. L. Hollis and F. C. Stark.
- 2-77-b Efficacy and Selectivity of Chemical Herbicides for Controlling Major Weed Species in Truck Crop Production. J. D. Riggelman, W. A. Matthews, F. C. Stark, and G. J. Stadelbacher.
- 2-79-g Changes in Chemical Composition of the Sweet Potato During Development, Storage and Processing as Related to Quality of the Final Product. L. E. Scott, W. A. Matthews, F. C. Stark, R. A. Baumgardner, Esam Ahmed, and T. L. Seen.

- Q-79-h Influence of Nutrient Intensity and Balance on the Growth, Yield and Quality of Cauliflower. C. W. Reynolds and F. C. Stark.
- Q-81 Cantaloupe Breeding and Selection with Particular Reference to Quality and Resistance to Defoliation. F. C. Stark and W. A. Matthews.
- Q-81-b Sweet Potato Breeding and Selection with Particular Reference to Quality and Resistance to Cracking. F. C. Stark, L. E. Scott, and W. A. Matthews.
- Q-81-c Sweet Corn Breeding with Particular Reference to the Utilization of Cytoplasmic Male Sterility in the Production of F_1 Hybrid Seed Corn. R. J. Snyder, F. C. Stark, and Gordon Johnston.
- Q-81-d Tomato Breeding and Selection with Particular Reference to Adaptation to Mechanical Harvest and to Processing. F. C. Stark, J. D. Long, B. D. Horton, and Dorothy A. White.
- Q-83 Soil and Plant Factors Affecting Water Utilization by Selected Vegetable Crops. C. W. Reynolds and F. C. Stark.
- QRA-1 The Retention of Market Quality of Sweet Potatoes by Improved Methods of Harvesting, Grading and Handling. L. E. Scott, W. A. Matthews, H. S. Todd, G. J. Burkhardt, L. C. O'Day, and Daniel Swope.

Department of Poultry Science

- M-32-m Genetic Differences in Alkaline Phosphatase Concentration of Blood Sera as Related to Differences in Egg Production and Egg Quality. F. H. Wilcox, C. S. Shaffner, H. V. Auger, and H. R. Wilson.
- M-33-e Genetic Control of Serum Cholesterol Level. F. H. Wilcox, C. S. Shaffner, H. R. Wilson, and H. V. Auger.
- M-35-m Development of Improved Rations and Feeding Methods for Laying Chickens. G. F. Combs, N. V. Helbacka, G. R. Childs, D. F. Middendorf, D. L. Blamberg, E. H. Bossard, and A. Spandorf.
- M-48 Microbiological Studies Pertaining to Poultry Nutrition. Mary S. Shorb, W. O. Pollard, P. G. Lund, R. Bishop, A. Matteson, M. Hansen and H. Walker.
- M-53 A Study of the Relationships between High Ambient Temperature and the Shell Thickness of Market Eggs. N. V. Helbacka, C. Smith, and J. L. Casterline.
- M-55 The Perception and Preference of Chickens for Different Colors. G. D. Quigley.
- M-57 Genetic or Other Explanation of Variation of Louse Numbers on Poultry. G. D. Quigley.
- M-58 Metabolic and Nutritional Studies on Microorganisms Important to the Poultry Industry. Mary Shorb, P. G. Lund, and W. O. Pollard.
- M-59 Lipid Metabolism of Fowl Spermatozoa. Mary Shorb.
- M-60 Test of an Insecticide (Co-Ral) as a Systemic Insecticide for Poultry. G. D. Quigley and W. Harding.
- M-100 Quality Retention in Poultry Meats as Influenced by Methods of Processing. N. V. Helbacka, C. S. Smith, A. Kotula, and C. S. Shaffner.
- M-200 Studies on Improved Broiler Nutrition. G. F. Combs, J. L. Nicholson, J. L. Milligan, and R. D. Creek.
- M-201 Vitamins and Unidentified Organic Factors in Poultry Nutrition. G. F. Combs, B. Panda, G. R. Childs, and R. D. Creek.
- M-202 Protein and Amino Acids in Poultry Nutrition. G. F. Combs, G. R. Childs, E. H. Bassard, D. L. Blamberg, A. Spandorf, and J. L. Milligan.
- M-203 Trace Minerals in Poultry Nutrition. W. C. Supplee, G. F. Combs, R. D. Creek, N. V. Helbacka, O. D. Keene, and C. S. Shaffner.
- M-204 Nutrition and Bone Anomalies in Chicks and Turkeys. R. D. Creek, Valeria Vasaitis, and W. O. Pollard.
- M-205 Mycotoxicoses as Related to Poultry Nutrition and Various Unidentified Poultry Meladies. R. D. Creek, H. M. DeVolt, and N. C. Laffer.

- M-301 Effect of Ambient Temperature on Efficiency of Broiler Production. C. S. Shaffner, J. L. Milligan, and L. N. Winn.
- M-302 Effect of Freezing and Reversible Inhibitors on Chicken Sperm. F. H. Wilcox and C. S. Shaffner.
- M-400 Effect of Protein Adequacy on the Efficiency of Selection for Early Fattening of Turkeys. C. S. Shaffner, G. F. Combs, G. D. Quigley, and F. M. Attia.

Department of Veterinary Science

- D-52 Respiratory Disease of Poultry. H. M. DeVolt, S. B. Mohanty, S. Chang, and W. D. Keenum.
- D-57 Epizootiology of Equine Encephalitis in Maryland. R. J. Byrne, Frances S. Yancey, M. J. Collins, and R. W. March.
- D-58 Infectious Bovine Mastitis. J. D. Kornder and Gertrude M. Jones.
- D-59 An Investigation of "Air-Sac Infection" in Poultry. H. M. DeVolt, J. K. Noel, A. P. Holst, and W. D. Keenum.
- D-60 Investigations on Brucellosis of Cattle. C. Cotton.
- D-61 A Study of Ruminant Metabolism with Emphasis Upon Its Relation to Ketosis. R. B. Johnson.
- D-62 Infectious Diseases Affecting Reproduction in Cattle with Special Reference to Vibriosis and Leptospirosis. G. J. Plumer, Virginia M. Shepler, R. J. Byrne, Frances S. Yancey, and W. R. Anderson.
- D-63 Study of Bovine Respiratory Diseases. R. J. Byrne, S. C. Chang, G. J. Plumer, M. Lillie, and G. J. Spahn.



In addition to state and federal funds, the research program of the University of Maryland Agricultural Experiment Station has received support during the year from many public, private and industrial organizations and individuals. It is regretted that space does not permit recognition of all sources of help, but the cooperation of all is herewith gratefully acknowledged.

UNIVERSITY OF MARYLAND
AGRICULTURAL EXPERIMENT STATION

Visitors will be welcome at all times, and will be given every opportunity to inspect the work of the Agricultural Experiment Station in all its departments.

The Bulletins and Reports of the Station will be mailed free of charge to all residents of the State who request them.

University of Maryland
AGRICULTURAL EXPERIMENT STATION
College Park, Maryland

DO  CIRCULATE

